CERTIFICATION OF APPROVAL

UTP Knowledge Based Healthcare Information Services

by

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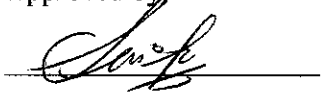
Approved by,



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UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

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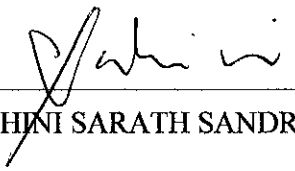
CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



DAARSHINI SARATH SANDRAN

ABSTRACT

This report is an extension of the proposal that was submitted for approval as a Final Year Project. It outlines the implementation of UTP Knowledge Based Healthcare Information Services. UTP Knowledge Based Healthcare Information Services will be developed to enhance the current system's functionalities and address issues such as redundancy while providing informative and feedback to system users, who are the staff of UTP Health Clinic, students and lecturer's, to provide a better standard of clinical services. Among the benefits attainable by the UTP Health Clinic with the UTP Knowledge Based Healthcare Information Services are productivity, time savings, improved quality of care and profitability. For implementation, a basis for literature review is determined and steps to conduct this scientific research is determined to derive a hypothesis that builds on the works of others and relating its concepts to implement UTP Knowledge Based Healthcare Information Services. The methodology of the project is discussed where a complete research of the component-based software engineering research is done based on the UTP Knowledge Based Healthcare Information Services case. Finally, the purpose of gathering data together with its conclusions and recommendations are briefly described in this report.

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Firstly, I would like to thank God for giving me the chance to be able to engage in this project. With Him, all things are possible.

Secondly, I would like to thank my supervisor, Mrs. Savita K Sugathan for her guidance and advice that has proven to be valuable in communicating how a Final Year Project should be done.

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ABBREVIATIONS AND NOMENCLATURES

- UTP: Universiti Teknologi PETRONAS
- ACS: Academic Central Services
- ICT: Information Communication Technology
- BIS: Business Information Systems
- LAN: Local Area Network
- MOH: Ministry of Health
- MMA: Malaysian Medical Association
- GP: General Practitioners
- HMO: Health Maintenance Organizations
- HIS: Hospital Information Services
- CDSS: Clinical Decision Support System
- CHF: Congestive Heart Failure
- CPR: Computer Based Patient Record
- KBS: Knowledge Based System
- TAM: Technology Acceptance Model

CHAPTER 1

INTRODUCTION

1.1 Background of study

UTP Knowledge Based Healthcare Information Web Services

UTP Knowledge Based Healthcare Information Web Services is an internet-based hospital and clinical system that provides a set of web services providers (MOH, MMA, and GP, pharmacists, nurses and so forth) can use to manage their information and for users to get cheap medical advice from an expert. This service will meet a growing practice's need for standardization and flexibility. It is an electronic substitute for the paper based system and will become a tool to assure the quality of healthcare delivered. UTP Knowledge Based Healthcare Information Web Services is the basis to the standardization of healthcare using the principles developed in evidence-based medicine.

Healthcare Information Managing Process in UTP Health Clinic

As of now, UTP Health Clinic functions in the following areas as follows:

1. Patient Management System

   The current method used to manage patients is card system and also entering data into the database to keep a record of patients. Cards are used to provide a more detailed description of an illness. For example, when a patient with an acne history comes for treatment the doctor needs to draw a face and indicate the areas which are affected in the card.

2. Pharmacy and Inventory System

   The management of inventory is done through a countdown where the items checked in and out and tallied to make sure there will be no access of supplies. This is done manually also.

3. Prescription Management System

The prescriptions given to a patient is keyed into the database from a computer at the premises of the clinic.

4. Appointment System

Appointments are only needed for patients that require follow up of check up and this is done manually in a paper based format.

1.2 Background of project

First and foremost, the project starts by an investigation of the problems faced by the clinic administrators in their business with the current manual method. Then a practical and feasible solution is introduced in this case being the UTP Knowledge Based Healthcare Information Web Services that will meet the needs of the stakeholders as well as lessen their burdens in managing the clinic. At the same time, new ideas are generated in improving the functionality of the web service. The project aims to solve the problems and troubles caused by the current method of using a manual system. At the end of the project, a standardized, efficient and better performing tool is to be delivered that will meet user's satisfaction.

1.3 Problem Statement

UTP Knowledge Based Healthcare Information Web Services is feasible to be implemented in UTP Health Clinic due to the following reasons:

1. The analysis of the current manual system showed room for improvement by automating the existing method of data storing and inventory management.
2. The current paper based system used is space consuming and messy.
3. It is not extensible and takes time to be updated.
4. It is prone to discrepancies and other human error.

1.4 Objectives and Scope of Study

The objective of the UTP Knowledge Based Healthcare Information Service is:

1. To develop a tool that eases the burden of storing patient records while also facilitating the accounting of records.
2. To develop a tool that requires minimum space and is orderly.
3. To develop tool that is not time consuming and is extensible.
4. To educate users on the importance of healthcare.
5. To promote knowledge sharing in terms of healthcare.

1.5 Project Activities

1. Plan the scope of the project: To be completed within 1 year period and involves UTP students, staff and lecturers only.(LAN environment)
2. Analyze the current system: Analyze the system in terms of efficiency, functionality, user satisfaction levels, response time and probability of error and error rates.
3. Design: Preparation of design documents (UML diagrams, User interface, proposed algorithms, support tools, etc.)
4. Implementation: Development of prototypes based on Component-based Software Engineering concept.
5. Roll Out: Deployment of Healthcare Information Web Services to real environment for field testing and user acceptance testing. (Beta Testing)
6. Training: Training users of the system (Staff and Management (upon request)).
7. Economic Analysis: Feasibility of implementing Healthcare Information Web Services against the returns generated from using Healthcare Information Web Services.

CHAPTER 2

LITERATURE REVIEW AND/OR THEORY

2.1 Research purpose:

Show that theories or evidence designed for some purpose in one literature could be applied in another literature to solve an existing but apparently unrelated problem (king et al., 1994, 16-17)

Healthcare Information Services will be used to help UTP Health Clinic's staff in managing their information services such as patient information, appointment management, prescription information, and pharmacy and inventory management. It uses data entry and query based transaction in running basically. Therefore, not only does the clinic staff improve their standard of services but the patients themselves benefit from the fast and effective clinic. Hence, a research will be performed in order to determine the downfalls of using a manual system in a clinic and how automation will improve the performance of the services. After zooming into the areas that need improvement, the tool is altered to be able to provide a solution to overcome the problems faced based on the hypothetical analysis that has been done.

While the technical aspect of medicine seems alive and well, the move to manage medicine from the financial perspective has added huge layers of bureaucratic and administrative functions that beg for IT solutions. (Phillip et al., "Healthcare Information System", 2003, 3)

The healthcare industry has been progressing just like technology, but technology has been advancing faster. Problems found in the traditional paper based system used in the healthcare industry have been an eye opener to technologist as they see potential improvement in the healthcare industry through automation. As stated above the move to manage medicine from a financial perspective requires IT solutions.

Healthcare organizations are spending millions to upgrade their systems. (Kiel, "Information Technology for the Practicing Physician", 2001, pg 4)

Like health care, information technology is a continuing, evolving industry. Healthcare organizations are spending millions to upgrade their systems. At Sutter Health in Northern California, the technology budget doubled in the years 1997 to 1999 to $79 million and staffing tripled to more than 500 positions. (Kiel, "Information Technology for the Practicing Physician", 2001, pg 4). It is not uncommon for large healthcare systems to be spending on technology ten times what they were only five years ago. Combining the changes in healthcare and information technology can result in an evolutionary dynamic.

The need to be able to track patient data for utilization statistics (an absolute must for managed care) is pushing the development of data warehouse and electronic patient medical records. (Phillip et al., "Healthcare Information System", 2003, pg 3)

With the emergence of evidence-based, data-driven medicine in the U.S. however, the representation of the patient, and ultimately the organization's measured quality of care, is primarily represented by data rather than intensive, personal interaction with the patient (1994). (Robert et al., "Data Quality Assessment Method in Healthcare Information System, Journal of Knowledge Management Practice, March 2001)

From the first text we can see that it is a crucial part of the healthcare management process to track patient data for utilization of statistics and without the data warehouse and electronic patient medical records it is going to be a mess managing these information. With the possibility of a growth of data capacity from time to time the only measure feasible will be to employ automation and use the system to manage records. Then we look at the second text, where it is proven that personal interaction alone is not

enough for a successful and efficient healthcare service. There is beyond that personal and caring side of medicine to care and provide medical care to a patient. It does not only concern the medicine and patient care, but a major part of it involves the technical aspect of data storing specifically.

"We've watched our operating margins shrink over the last three years. We're all being challenged by declining reimbursements and the need to tighten the ways we manage our care. Physicians today probably make 85% to 90% of the decisions that ultimately end up in our cost structure," says David Weiss, CIO, BJC Health Systems, and St. Louis, Missouri. (Kiel, "Information Technology for the Practicing Physician", 2001, pg 110)

From this excerpt, we can see the importance of automation in healthcare in terms of reducing the cost incurred in the operations of a clinic and hospitals. It is wise to conduct a business and pay attention to cost reduction in order to increase profits in the long run. Therefore, it is advisable for the UTP Health Clinic to incorporate the Knowledge Based Healthcare Information Services.

Accordingly, a revolution is taking place in the healthcare industry, with IT playing an increasingly significant role in its delivery, as shown in Figure 1. In 1996, healthcare spending on IT alone was estimated to be between $10 billion and $12 billion. (Wullianallur et al., "Healthcare Information System", 2003, pg 10-11)

Realizing the importance of automation and IT in the world today, healthcare industries are willing to spend huge amounts on IT and automation to keep in pare with the trend of automation in businesses today. This is to avoid cost of fixing failures and errors which could cost more than automating the business itself.

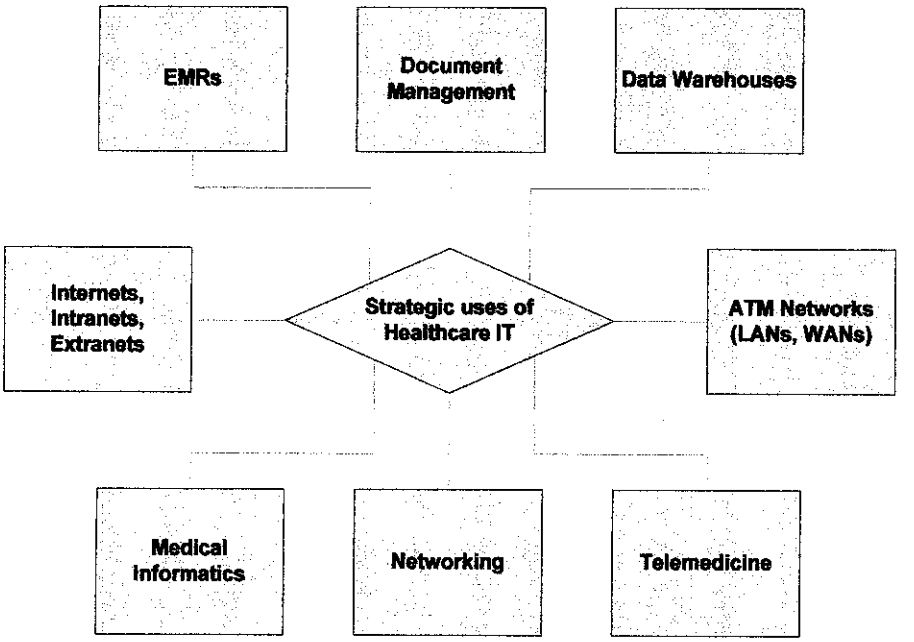

Figure 1: Strategic Uses of IT in Healthcare

Today, hospitals and HMOs are demanding a move from stand-alone, fragmented information systems to integrate HIS and CDSS. (Wullianallur et al., "Healthcare Information System", 2003, pg 9)

In other words, all related parties, including profit and nonprofit healthcare stakeholders, providers(e.g. hospitals), payers(e.g. insurance companies), employers, practitioners, public health officials, educators, and others(e.g. consumers) must meet the challenge of addressing these new expectations. (Phillip et al., "Healthcare Information System", 2003, pg 10)

This is a clear sign that healthcare services around should keep in pare with the latest development in the medical world. Therefore, it is advisable for UTP Health Clinic to automate its management system in order to provide a better standard of services to the UTP staff and students.

As such, the quality of data maintained by the organization becomes a critical factor in the ultimate delivery of care, and the need for more rigorous quality assessment

methodologies becomes apparent, requiring the inclusion of assessment of data comprehensiveness, consistency, currency, relevance, and timeliness.

Today, with the increasing deployment of decision support systems at the provider level, application of data quality improvement is less likely to be found objectionable in the establishment of standards for information application and management in health care, in the care and treatment of patients as well as the management of the system where they are treated.

Data quality indicators have been developed related to the standardization of patient information and the formatting and submission of data, along with payment standards through electronic funds transfer and communication with providers through electronic mail. Likewise, standards for uniformity of clinical records are actively being pursued. Such systems are designed to create a paperless claims system, and create a comprehensive database of healthcare practices and outcomes involving Medicare recipients. The American National Standards Institute (ANSI), among others, is actively developing system standards for this process.

In day to day practice, reliable data quality can enhance the judgement that individual clinicians acquire through training and practice. Increased clinical performance is thus achieved in many ways, but especially in better-informed diagnosis and in more complete identification of treatment options and application of an expanded knowledge based in day-to-day practice.

The above excerpts were from: Robert et al., "Data Quality Assessment Method in Healthcare Information System, Journal of Knowledge Management Practice, March 2001)

It is important for data to have comprehensiveness, consistency, currency, relevance, and timeliness. This can be achieved through the system as the database is a reliable medium for data storing. The importance of data integrity can be seen from the second excerpt where application of data quality improvement is likely to be found objectionable. There

is a standard of uniformity that is important hence, it is actively being pursued. There is a standard being developed for this as well. As users progress from day to day, data quality can enhance user's judgement on the system from training and practice.

For an organization to cope effectively with a rapidly changing environment of the sort we see increasingly in today's global context, it must be able to (1) import information efficiently; (2) move that information to the right place in the organization, where it can be analyzed, digested, and acted upon; (3) make the necessary internal transformations to take account of the new information; and (4) get feedback on the impacts of its new responses, which starts the whole coping cycle via information gathering all over again. (Schein, Organizational Culture and Leadership, 1980)

Translating this to IT language would mean:

1. Must be able to input and receive data across system interfaces that are accurate.
   - ✓ In the proposed system we will be using the keyboard, mouse, web interface which is available at the premises of the clinic for data input and receiving data.
2. Store data in a format that is useable and accessible by those with permission to view it.
   - ✓ For this scenario we have the database which will be storing data in a format that is useable and admin access can be set for a certain person's access only.
3. Validate the integrity of the data.
   - ✓ Database will promise the integrity of the data input through certain conditions during the coding process where the data type and so on can be set.
4. Able to monitor and measure system and user response to the data.
   - ✓ This can be done through beta testing.
   - ✓

Knowledge Management and Knowledge Based Systems

Making decisions is one of the primary functions of an executive or manager. To efficiently perform this function, executives and managers must have convenient access

to up to date information and detailed knowledge for specific business operations or business situations.

What Is Knowledge and Why Does It Have to Be Managed?

In the business context, knowledge can be broadly defined as the cumulative "know-how" of all employees involved in your company's business activities. This ultimately distinguishes knowledge from data.
While the term 'data' refers to a collection of facts, the term 'knowledge' is used to denote "know-how" utilized for reasoning with already known facts to produce new facts, recommendations and forecasts.
(http://www.logexsoft.com/knowledge_management.php)

In the course of their employment with a company, professionals in all divisions and at all organizational levels accumulate valuable knowledge. A significant part of this knowledge is distributed among various documents and computer systems. Another significant part is carried exclusively by employees and exists in their minds and personal notes. When an employee retires or quits the company for whatever reason, part of his business knowledge remains in the company while the substantial amount of it leaves with the employee. A large amount of accumulated knowledge is lost when employees are given new assignment or are transferred to other areas. The loss of this accumulated knowledge, which should be thought of as the most valuable enterprise asset, is hard to quantify, however overall corporate experience suggests that such losses can result in major disruptions and/or severe performance declines. Knowledge is the major non-tangible asset of any business. In essence, it is the 'intellectual capital' which should be carefully accumulated, preserved and utilized for increasing shareholder value and generating growth.

"During the 1980s, downsizing was the popular strategy to reduce overhead and increase profits, but the downside to being lean and mean soon became evident: When employees left, they took with them all the intellectual capital they had accumulated through the years."They knew how to do things, how to sell things, even where things were stored,"

says an executive. "When that information left, organizations had to reinvent the wheel. And when you have to reinvent something, it's costing you money." (Forbes ASAP, April 7, 1997)

Just as processes, structures and systems are required to manage a valuable 'tangible' company asset (such as capital, equipment and people), knowledge, while not considered tangible, also has to be managed.

Knowledge management is the broad process of locating, organizing, producing, storing, preserving, transferring, and using corporate key expertise within an enterprise. (http://www.logexsoft.com/knowledge_management.php)

Good knowledge management practices should be seen as a crucial element for managing all internal business and operational processes and perhaps, more importantly, be seen as a major means of gaining and sustaining competitive advantage.

Employees involved in decision making and other intellectual activities produce a significant amount of knowledge in the course of their employment. However, this knowledge is difficult to tap into by those who did not participate in its creation.

For example, ideas and "know-how" are usually "hard-wired" in computer code and are tuned to solve some specific problem or perform a very rigid sequence of actions. Knowledge contained in such programs cannot be easily transferred for its use in other applications or for other problem solving. Large amounts of knowledge is contained in numerous corporate documents. However, specific elements of this knowledge are typically difficult if not impossible to find when required to quickly address a problem, which may need immediate attention.

In other words, sources such as documents and computer programs contain knowledge in an implicit form, i.e. in a form that does not support convenient access and required application of such knowledge. (http://www.logexsoft.com/knowledge_management.php)

Prior industry experience demonstrates that it is impossible to make efficient use of data unless data is properly organized in a database. The same is true for knowledge: it has to

be stored, organized and managed in a "knowledge base". The key to creating knowledge bases is to extract knowledge contained in various sources in implicit form and to transform it into an explicit representation. Once this is accomplished, a technology for knowledge management can be utilized to expand and refine the company's knowledge bases and, ultimately, put them to work for supporting decision making throughout the whole organization. The technology that enables the creation, management and exploitation of knowledge bases is known as knowledge-based systems.

Knowledge-Based Systems (KBS) are computer programs that capture valuable decision-making knowledge in an explicit form so it can be used for solving problems by less experienced and knowledgeable people.
(http://www.logexsoft.com/knowledge_management.php)

Since KBS are often used to capture knowledge of domain experts who are very skilled and experienced in specific areas, they are also referred to as expert systems.

Knowledge bases are central repositories for an organization's knowledge. Knowledge becomes a resource that can be stored and reused by employees anytime, anywhere and anyplace. Each individual then becomes empowered with the total knowledge of the company. This knowledge multiplying effect can result in enormous positive benefits and a tremendous competitive advantage.

Special knowledge representation languages are available to develop knowledge-based systems. Such languages include semantic networks, various logics based on predicate calculus, frames, rules, etc.

The knowledge-rich nature of the healthcare domain has made it an ideal environment for the application of knowledge-based techniques.

CHAPTER 3

METHODOLOGY/PROJECT WORK

3.1 System Analysis

System analysis provides critical information of a project development since it provides detailed information and raises issues faced by the current system. The strategies deployed from this phase include:

- **System Modeling**

System Modeling expresses detailed system requirements from a technical perspective.

- **Study Phase**

Manual System vs. Proposed Automated System: A Comparative Analysis

Purpose: To enhance efficiency of the current manual medical information service to further meet the specific needs of its users by providing useful and informative data representation by applying various data management method's available in the industry. Therefore, a study is needed to determine the pitfalls and weaknesses of the current system so that a solution can be suggested to the additional issues rectified. This objective can be achieved through:

- Data Collection
    - Interviews, observations, surveys and questionnaires on system stakeholders from:
        - UTP Health Clinic receptionists
        - UTP Health Clinic doctors
        - UTP students
        - Existing Healthcare System users

3.2 Data Gathering – Interview with Dr. Hjh Sa'dah Idris Samadi UTP Health Clinic Medical Representative.

An interview was conducted with Dr. Hjh Sa'dah Idris Samadi to represent Management's perception on the implementation of a Healthcare Information Service tool in the UTP Health Clinic. **(See Appendix 1-1 for questions)**Meanwhile, the information gathered from this interview is also used to observe the current business processes as part of the analysis of the current system available in the clinic. This is to ensure that the system will be developed solely to serve an existing need in the clinic instead of merely developing another system which is already in place.

3.2.1 Interview Questions

The interview is to probe the Management awareness, perception and attitude towards the implementation of this tool as a support service for the clinic and to understand how far this system will be accepted as being useful to staff and students from Management's viewpoint.

The interview questions can be divided into three categories:

3.2.2 Current process flow

Question 1 is asked to know the existing systems in the process flow and business flow of the UTP Health Clinic. There are four options given and the interviewee is to mention yes or no to these modules. Question 2 till 5 is an extension of Question 1 where it is prompted to get information regarding the process flow of each module mentioned yes to in Question 1. Question 2 is to gain information regarding the Patient Management System. Question 3 is regarding the Pharmacy and Inventory Management System and Question 4 on the Prescription Management System. Lastly, Question 5 is regarding the process flow of the Appointment System.

3.2.3 Control Questions

Control questions are asked to indirectly find the level of interest in implementing the Healthcare Information Services system in the interviewee's opinion. In this interview there are two control questions which are Questions 6 and 7. Question 6 attempts to find out the feasibility of implementing the current management methods in the clinic. Question 7 is a direct attempt of promoting and letting the management know of the

proposal and idea of Healthcare Information Services and requiring their interest in deploying the system in UTP Health Clinic.

3.2.4 Supporting answers and additional suggestions

These can be found in Question 8 where it requires the interviewee to grade the proposed modules for the system from level 1 till 4, 1 being the highest and 4 being the lowest. This is to attract the management's attention during the proposal of the system later on as it would be the modules their interested in.

3.3 Data Gathering – Survey Questionnaire

3.3.1 Data Gathering

The survey questionnaire requires a procedure of obtaining feedback from a clustered sample of students which is an adaptation of methods introduced in (Abouchedid and Nasser, 2002, p. 200) to suit the current setting of student population in UTP. The steps involved in each phase will be described as we progress.

3.3.2 Questionnaire Creation

The first phase is the questionnaire creation which consists of two parts which were catered for UTP students (see **Appendix 1-2**). The first part is to obtain standard demographic and background information gender, course, country and race of the respondent.

The second part of the questionnaire is to obtain the respondents perspective on the Knowledge Based Healthcare Information Service to be implemented in coordination with the UTP Health Clinic. The questions in this part can be divided into the following:

3.3.3 Control Question

There is one control question in this part which aims to estimate the feasibility of implementing the proposed healthcare tool. The question involved here is Question 1 which asks the respondent if they are interested in using the Knowledge Based Healthcare Information Services.

3.3.4 Perception and Awareness

This part aims to get the level of knowledge and awareness students have on healthcare and their interest in healthcare. This is so that, the tool when implemented will not be

redundant and has a potential on upgrading the health standards of UTP. Question 2 requires respondents to rank their criteria for effective and usability of the proposed healthcare tool, where for mode of delivery they were required to specify the exact mode. Question 3 requires the respondent to rank the level of interest in terms of health knowledge in a list of 6 health issues found among young adults these days. Question 4 is an extension of Question 3 where the user's awareness in health issues is tested, by requesting to suggest any other issues that would be good to learn about in this tool.

3.3.5 Level of Interest

This part aims to estimate the level of interest students have in using the features of the healthcare tool. Therefore, they are required to choose the functions that interest them the most in the system once it was implemented. Questions 3 and 5 contribute equally to this section.

3.3.6 Questionnaire Distribution

Sample Selection

A sample size of 30 people were selected in this analysis, all ranging from different countries, race and culture so that there is a good mix and a probability of getting good hypothesis. This satisfies the validity criteria as opinions from all levels were selected to account for perception and opinions.

Distribution and Collection Strategy

There was a distribution of questionnaire to a random set of 30 students so that there is a good mix of sample type. The main weakness of this method was that there were respondents who did not understand the questions posted and did not answer the question accordingly. One of the reasons to this would be lack of technical knowledge and health education concern. This is a good reason to impose this system in the university as well.

3.3.4 Data analysis and interpretation

For analyzing the control questions and level of interest, the mean, variance and standard deviation was calculated. Each option was assigned a weight and the total scores were multiplied by the assigned weight.

For analyzing the perception and awareness category, the answers provided by the students were summarized by categorizing student's answers and opinions. This will be further discussed in the results and discussion.

3.4 Data Gathering – SWOT Analysis

A SWOT Analysis is is a strategic planning tool to evaluate the Strengths, Weaknesses, Opportunities, and Threats in a project, a business venture, or any other situation of an organization or individual requiring a decision in pursuit of an objective. It monitors the marketing environment internal and external to the organization or individual.

A SWOT Analysis is done on the Knowledge Based Healthcare Information Services to evaluate strategically the feasibility of continuing this system. The results of this analysis will be discussed in the results and discussion section.

3.5 System architecture design

3.5.1 Design documents

Design documents are explained in **Table 1** that describes the use of each document and the scope of the document.

No.	Document	Purpose	Scope
1	System Requirement Specification	To detail out the requirements of the proposed system in terms of functional requirements and also specify non-functional requirements for the system.	Hardware and software specifications, system functions and conditions to determine satisfactory usage of the proposed system
2	Use Case Specification	To summarize system interaction with users and the external environment and to specify the situations where each function is used	System stakeholders, external systems, relationships, non-functional requirements

3	Structural Model Specification	To represent each object, whether a function or a user as specified in the Use-Case specification as an object with attributes and methods (specific functions that is associated with the object). Objects with same attributes and methods are grouped into classes and relationships between classes are determined.	System stakeholders information, access level granted to each stakeholder and functions available for each stakeholder groups (Students, clinic management, system administrators)
4	Behavioral Model Specification	To specify the flow of interaction between an object and system functions by triggering the methods available in the object and show how system functions respond to users' requests	System stakeholders, system functions, methods

Table 1 Design documents specification

3.5.2 User Interface design and storyboarding

A standard web template will be created for the reporting system and the storyboard will elaborate on the actual program flow and interaction designs for the system.

3.5.3 Prototype design and creation

A prototype of the system will be used to validate the ideas proposed in this project and used as a means to evaluate the feasibility of implementing the system. Screen captures of the system can be seen in the results and discussion section.

3.6 Tools Selection

3.6.1 Study of available tools and implementation strategies

Since the system will be developed as a web based system, the following issues should be taken into consideration when evaluating the identified tools and implementation strategies:

Current hardware and software requirements

The proposed system has to be developed on a compatible platform based on the host system where it will be accessed by students and faculty members. Therefore, a background study should be conducted to determine its specific hardware and software requirements in order to develop the system to suit the underlying host system without any complications. Also, a proposal to acquire a dedicated server to accommodate the computation and distribution needs for the system can be made should the need arises. The information required to be obtained include all hardware and software specifications currently used by the clinic to host their individual web pages and current database server that can be used to accommodate the storage needs of the proposed system.

3.6.2 System Design Component Based Software Engineering Approach

Health Information Services will be developed as an extension to the current semi manual Medical Information System used in UTP Health Clinic. A reuse oriented approach is proposed to identify tools and systems that are available in the market to be integrated with the current method used in managing Healthcare Information Services. There will be customization of other specific requirements requested by stakeholders through the chosen tools. The stages identified are:

- Component Analysis

  Analyze tools in the market to implement Healthcare Information Services. (data management tools, Web-based programming languages)

- Requirements Modification

  Analyze requirements using information about acquired components to modify it to reflect the available components.

- System design with reuse

  Design system framework or reuse existing framework to take into account reused and organize the framework to accommodate new components.

- Development and Integration

  Develop software that cannot be purchased or acquired and integrate these components to create a new system.

- Prototyping

Prototype is an initial version of a software system that is used to demonstrate concepts, try out design options and generally find out more about the problems and its possible solutions. Rapid Iterative development of the prototype is done to control costs and allow system stakeholders (staff of UTP Health Clinic) to experiment with prototype and provide feedback on how well the system works.

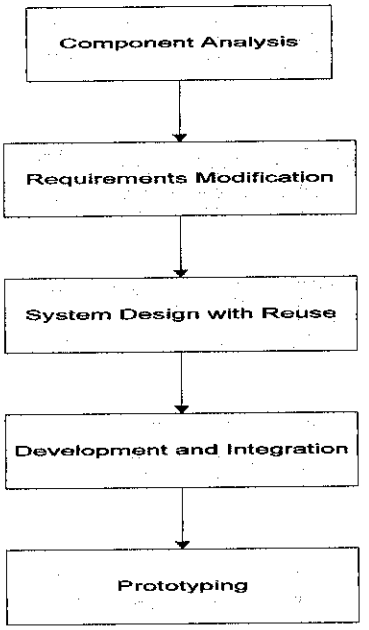

Figure 2: System Design Component Based Software Engineering Approach

3.6.3 Requirements Specification

The process of obtaining the necessary information to substantiate the need for implementation of the proposed system and to obtain background information on current relevant business processes in order to come up with detailed specifications of corresponding requirements as a means to achieve the objectives for developing this system.

Software Design

This phase requires all design documents to be specified as detailed in **Table 1.**

Software Implementation

The process of developing the system based on the specified requirements and constraints. This phase includes development of prototypes to be verified by system stakeholders in the testing phase.

System Testing

This phase verifies that the system is working as expected in the environment to be deployed and has satisfied all the necessary requirements of system stakeholders in a satisfactory manner. After the system has been approved by this phase, the system is ready to be released to the customer (here, UTP Health Clinic staff).

System Training and Roll out

The necessary skills and knowledge on how to use the system effectively to meet users' needs should be communicated to users through training, user manuals or dynamic help functions included in the system. Meanwhile, notification of the availability of the system within the clinic should be in place to inform all system users of the existence of such system.

3.6.4 Post-implementation Evaluation by Target Users

Upon development of a working prototype, a post-test survey questionnaire is designed and scales used to measure ease of use, usefulness, compatibility and use intentions were taken from current TAM scales (Davis, 1989; Taylor and Todd, 1995) The question of the survey conducted for this system was altered to suit the items to the current topic.

This exercise will be conducted among target audience in a residential village in the university and also the UTP Health Clinic staff where respondents will be granted access to UTP Knowledge Based Healthcare Information Services prototype and given a questionnaire. Users were required to rate UTP Knowledge Based Healthcare Information Services by exploring its functionalities on a 7-point scale (1 being strongly disagree and 7 being strongly agree). A sample questionnaire can be referred in **Appendix 1-3**.

Analysis of results from this post-evaluation exercise will be discussed in the next chapter. The results obtained from this exercise is essential as a basis for deciding whether to accept or reject the theoretical framework developed as an evaluation of the effectiveness of UTP Knowledge Based Healthcare Information Services implementation from the level of acceptance of its target users.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Data Gathering Results – Survey Questionnaire

Based on the survey conducted, an analysis of the results will be displayed as we progress according to the category stated in the Methodology.

4.1.1 Control Question

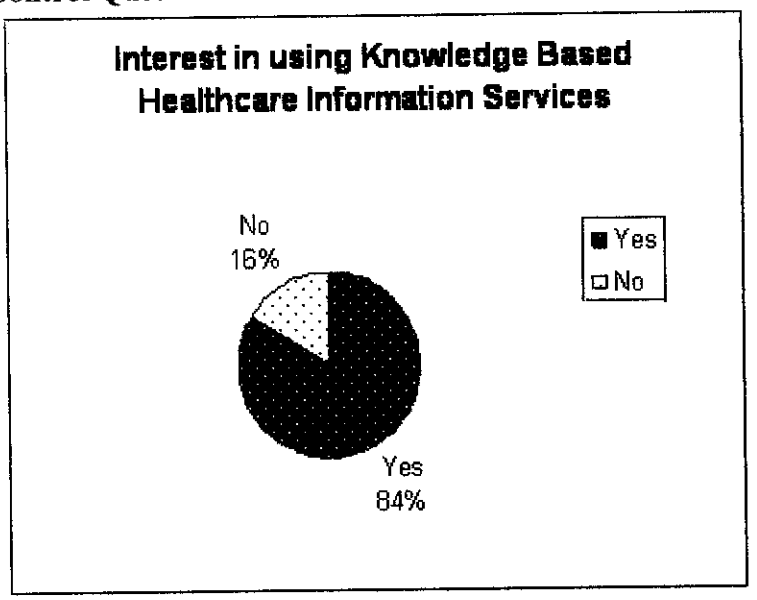

Figure 3: Interest in using Knowledge Based Healthcare Information Services

In Question 1, the users were asked if they were interested in using a Knowledge Based Healthcare Information Service after a brief introduction on the tool, 84% replied YES and 16% replied NO. The pie chart in Figure 3 shows these results. To calculate the variance, YES was weighted 1, NO was weighted 2 and N/A was weighted 3. Then the variance was calculated from the total number of respondents to arrive at the value, v = *0.198933* and its corresponding standard deviation, s = *0.446019*. With this small s value,

it can be deducted that majority respondents are very interested in this proposal for a Knowledge Based Healthcare Information Services.

4.1.2 Perception and Awareness

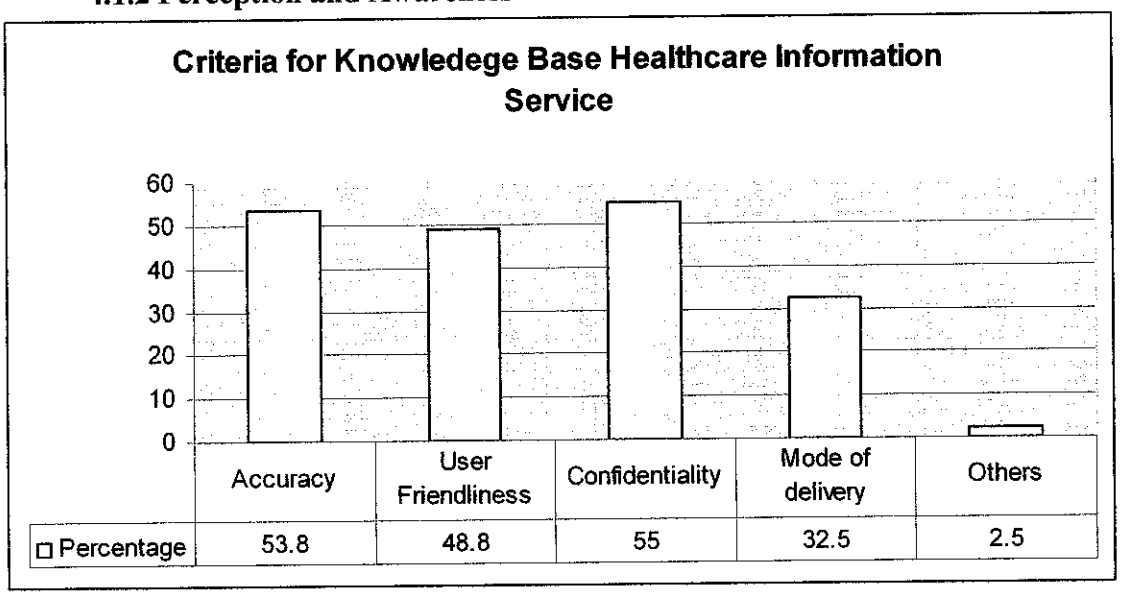

Figure 4: Criteria for Knowledge Based Healthcare Information Services

For Question 2 respondents are requested to select their preferred criteria's for the Knowledge Based Healthcare Information Services to be usable and effective. More than half of the sample selected Accuracy, User Friendliness and Confidentiality. Confidentiality is considered important as health related information is personal and users prefer a discreet system in these areas. As for mode of delivery where users were asked to specify the exact mode they would like to use, most of them listed internet, intranet and hand phones. The others here can be ignored as this number does not understand the question and what was required from it.

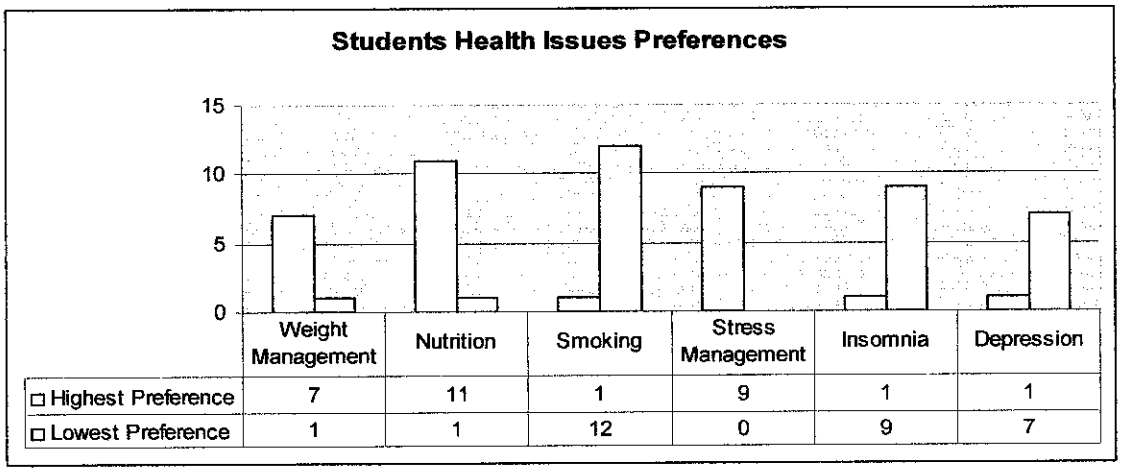

Figure 5: Students Health Issues Preferences

For Question 3, respondents are required to rank between 6 listed health issues according to their interest in learning more. The health issues are Weight Management, Nutrition, Smoking, Stress Management, Insomnia and Depression. From **Table 2**, we can rank these issues with 1 being the highest and 6 being the lowest:

Rank	Health Issues
1	Nutrition
2	Stress Management
3	Weight Management
4	Smoking
5	Insomnia
6	Depression

Table 2: Ranking in Health Issues

Question 4 is asked in order to find out if there are any other issues that interest students for further enhancements later on. It is an extension of Question 3. Among the issues listed are Brain Tumor, Muscle and Body Building, Drugs, Women's Healthcare, Sex Education, Sports Injury and Heart Disease.

4.1.3 Level of Interest

From Question 3 we get the health issues students are interested in similarly to the above section. Another question that tests this section is Question 5, where among the 3 modules that will be available for students which were they most attracted to. Majority of them were attracted to the Forum and the Health Promotion. The Forum is a function to

ease the process of obtaining information regarding health. As for the Health Promotion, there will be functions such as the BMI Calculator which calculates the Body Mass Index of the patient and later on displays general fat disposition areas in the human body. This continues to a healthy diet pyramid that shows the right amounts of nutrients that are needed. There is also another feature in this category which is the 'Diagnose Yourself!' section which is an interactive tool to allow users to identify symptoms to common illnesses such as the cough, flu and fever.

4.1.4 Data Analysis and Interpretation

From the collected and analyzed data, it is pretty clear that the system is feasible to be implemented in the UTP Health Clinic. Students are attracted to the forums and other features of the system. Hence, this tool can aid the healthcare service from its students and operators perspective.

4.2 Data Gathering Results - Interview with Dr. Hjh Sa'dah Idris Samadi of UTP Health Clinic

The questions posted to Dr. Hjh Sa'dah Idris Samadi of the UTP Health Clinic can be divided into three categories and result as follows:

4.2.1 Current business process

According to Dr. Hjh Sa'dah Idris Samadi, all the listed modules of the system exist in the management system of the clinic. The only setback is that they are all manually operated and paper dependant. The process flow of each module is as follows:

1. **Patient Management System**

   The current method used to manage patients is card system and also entering data into the database to keep a record of patients. Cards are used to provide a more detailed description of an illness. For example, when a patient with an acne history comes for treatment the doctor needs to draw a face and indicate the areas which are affected in the card.

2. **Pharmacy and Inventory System**

The management of inventory is done through a countdown where the items checked in and out and tallied to make sure there will be no access of supplies. This is done manually also.

3. **Prescription Management System**

The prescriptions given to a patient is keyed into the database from a computer at the premises of the clinic.

4. **Appointment System**

Appointments are only needed for patients that require follow up of check up and this is done manually in a paper based format.

4.2.2 Control Questions

Here Dr. Hjh Sa'dah Idris Samadi was asked whether the current system is feasible and her opinion on automation of the current processes.

Based on her description of the current system, there is a hypothesis that can be reached where a need of a system with reduced errors in data entry, accurate result findings by effective cross-checking between manual and automated systems, automation of certain manual processes and frequent update of system functionalities for an effective system is to be delivered in the system to be proposed.

Finally, Dr. Hjh Sa'dah Idris Samadi expressed her interest in deploying the Healthcare Information Services at the UTP Health Clinic if it is fully functional and well tested to be deployed in a real time environment.

4.3 Data Gathering – SWOT Analysis

Strengths Unique as it is knowledge based Caters for Students and staff Educates and increases awareness among students in terms of healthcare and issues	**Weaknesses** Not Wireless, available through internet and intranet only Doesn't cover a wide scope of health issues
Opportunities Recent increase in health concern among students compared to last time UTP increased its importance on health issues.	**Threats** Potential Redundancy of the system Possible errors and failures

Table 3: SWOT Analysis on Knowledge Based Healthcare Information Services

4.4 Selection of Proposed Tools and Strategies for Implementation

Having performed a comparative evaluation on the tools available, UTP Knowledge Based Healthcare Information Services will be built with the following specifications:

- SQL Server 2000
- Microsoft Visual Studio 2005

4.5 Results from post-implementation exercise using TAM

Evaluation of exercise results will be divided into the following categories (Mallat et. al, 2006):

4.5.1 Descriptive statistics

Frequency Distribution (Sekaran, 2003)

Construct	DISAGREE	NEUTRAL	AGREE
Ease of use	2.86%	8.57%	88.57%
Usefulness	0.00%	5.71%	94.29%
Compatibility	2.86%	2.86%	94.29%
Use Situation	0.00%	2.86%	97.14%
Use Intention	0.00%	5.71%	94.29%

Table 4: Frequency Distribution

Table 4 shows the frequency distribution obtained for the elements in this survey. The results show that majority of the users agree that UTP Knowledge Based Healthcare System is efficient in terms ease of use, usefulness, compatibility, use situation. A percentage of 94.29 agreed that they do have an intention of using the tool when deployed. Low percentage in negative responses can contribute to the likeliness of deploying the UTP Knowledge Based Healthcare System.

Measures of Central Dependencies and Dispersion

Descriptive statistics such as the maximum, minimum, means, standard deviations and variance were obtained for the elements used in this survey. Table 5 gives us a view of the results.

Construct	Minimum	Maximum	Mean	Std Deviation	Variance
Ease of Use	3	7	5.79	1.05	1.10
Usefulness	4	7	6.07	0.78	0.60
Compatibility	3	7	5.89	0.85	0.71
Use Situation	4	7	5.77	0.72	0.52
Use Intention	4	7	6.07	0.88	0.77

Table 5: Descriptive Statistics

The descriptive statistics show that all items for each variable were measured on a 7-point scale and the average was calculated to evaluate each criterion as a whole. From the table we can see that all mean were inclined towards the AGREE perception when measured against the 7-point scale. This indicates that users agree to the use of the UTP Knowledge Based Healthcare Information Services. The lowest mean computed was for Use Situation because there was a negative description for this element. Minimum and maximum of 4 and 7 for User Intention proves that users have an intention of using the UTP Knowledge Based Healthcare Information Services in the future. The variance is not high for most of the elements meaning that most responded close to the mean on all elements.

Following the examination of the descriptive data, the proposed research model was then evaluated using the structural equation modeling (EQA). The analysis consists of two main steps which are:

- Measurement Model – to propose validity and reliability for the proposed theoretical constructs.
- Structural Model - to conduct a path analysis and to test the hypothesis proposed in the research model.

4.5.2 Measurement Model

The purpose of this measurement model is to describe how well the observed indicators serve as a measurement instrument for the latent variables (Jöreskog and Sorbom, 1993).The hypothesized model consists of 24 observed elements consisting of 5 latent constructs: Ease of Use, Usefulness, Compatibility, Use Intention and Use Situation. The results are described in **Table 6.**

Construct	Item t-value	Item R^2	Cronbach α
Ease of use	3.98	0.50	0.933
Usefulness	2.14	0.30	0.801
Compatibility	3.04	0.69	0.767
Use Situation	0.70	0.26	0.789
Use Intention	3.48	0.72	0.782

Table 6: Construct Reliability Measures

A *t*-test is done to see if there are any significant differences in the means for two groups of variables. From the results, the *t*-values supported individual item reliability. Subsequently, R^2 and Cronbach Alpha values prove that internal consistency reliability of measures used in this study can be considered to be good.

4.5.3 Structural Model

The next step of this analysis was to test the causal hypotheses presented in the research model by using structural equation modeling. Firstly, correlations among the variables was computed and summarized in Table 7.

Constructs	Ease of Use	Usefulness	Compatibility	Use Situation	Use Intention
Ease of Use	1.000				
Usefulness	0.574	1.000			
Compatibility	0.286	0.502	1.000		
Use Situation	0.408	0.477	0.637	1.000	
Use Intention	0.569	0.468	0.632	0.591	1.000

Table 7: Pearson Correlation

The critical value obtained from the Pearson Correlation table at 33 degrees of freedom (*df* = number of pairs-2) at the 0.05 level for a two-tailed test is between 0.361 and 0.334. All values computed exceeded this threshold value and it can therefore be concluded that the correlation between each variable is statistically significant; except the correlation between Ease of Use and Compatibility but this correlation can be ignored since there

were no predefined relationships between these two variables. Therefore, Hypotheses H2, H3, H4, H5 and H6 are substantiated and its corresponding null hypotheses are rejected.

Next, the relationship between two nominal variables using the Chi Square Test was performed between the variables to test its proposed relationships with regards to their independent characteristics of each other. Table 4.8 describes the values computed, with its corresponding p-values computed using its respective degrees of freedom (*df*).

	q1q5	q2q5	q3q5	q4q5	q2q4
Chi square	261.019	121.665	166.759	151.926	223.907
df	135	99	99	144	176
Probability	4.63E-10	0.060745	0.00002	0.309293	0.00848

Table 8: Chi Square

The probability values computed was lower than 0.05 when computing Chi square values between Ease of use and Use Intention, between Compatibility and Use Intention and Usefulness and Use Situation. Therefore, Hypotheses H2, H5 and H4 are statistically substantiated.

For the relationship between Usefulness and Use Intention, the value from the Chi Square table is read and compared with the computed Chi Square value using a 99 degree of freedom and a probability of 0.1 and the Chi Square value for this relationship is significant to be defined, allowing Hypothesis H3 to be accepted. On the contrary, the relationship between Use Situation and Use Intention is considered as not significant. Therefore, $H4_0$ is accepted instead.

The overall explanatory power of the model was estimated by looking at the R^2 values for the two dependent variables. Figure 4.8 depicts the results.

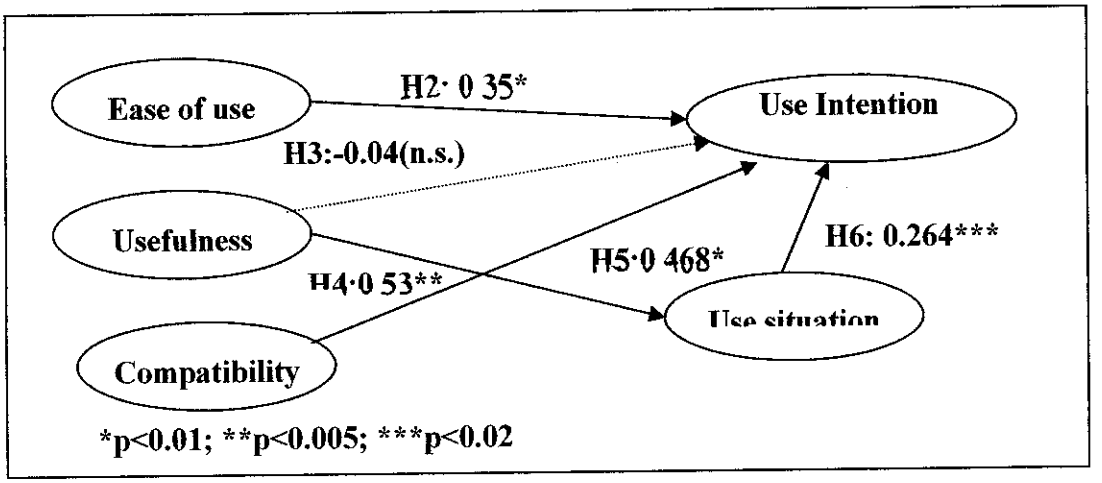

Figure 6: The estimated structural modal

From Figure 7, UTP Knowledge Based Healthcare Information Services usefulness explains 26% of the variance observed in users' perception on UTP Knowledge Based Healthcare Information Services use situation. Furthermore, Ease of Use, Usefulness, and Compatibility explained 72% of the variance in users' intention to use UTP Knowledge Based Healthcare Information Services in the future. Compared with earlier TAM studies, these explanation rates demonstrate highly satisfactory values.

Finally, the data provided support for most of the hypothesized causal paths of the research model. Ease of Use, and Compatibility had a direct positive relationship to Use Intention with standardized path coefficients being 0.35 and 0.53 respectively. The result provides support for Hypotheses H2 and H3. A surprising result was that the direct hypothesized path between Usefulness and Use Intention was insignificant, and the hypothesis H2 was therefore rejected. Instead, the effect of Usefulness to Use Intention was fully mediated by Use Situation with path coefficient value of 0.53 and 0.264. Hypotheses H4 and H6 were thus supported. Finally, use situation had a direct positive effect on use intention with 0.264 path coefficient, providing support for hypothesis H6.

Discussion

UTP Knowledge Based Healthcare Information Services is developed manage their information and for users to get cheap medical advice from an expert. Benefits of using UTP Knowledge Based Healthcare Information Services include more organized data

retrieval and effective data management while providing timely and useful information to its users at their convenience. Such benefits actualize in Use Situations, where context sensitive issues are addressed such as time and geographical locations.

The results obtained in this study provide support to the theoretical framework defined. Ease of Use, Use Situation and Compatibility were found to be significant determinants for users' intention to use UTP Knowledge Based Healthcare Information Services. Furthermore, Use Situation mediated the effect of Usefulness on Use Intention. The result implies that users value the benefits of Ease of Use, Usefulness and Compatibility and perceives UTP Knowledge Based Healthcare Information Services as useful in situations where there is a need to manage the huge chunk of clinical records and data. In these situations UTP Knowledge Based Healthcare Information Services is perceived as useful because it's faster and easier to manage data and the importance of education on health, is valued.

Results further provide support for the direct and significant effect of Ease of Use and Compatibility on Use Intention. This is plausible as convenience and ease of using a service are important factors in all situations. If UTP Knowledge Based Healthcare Information Services is too complicated and not user friendly, users will not be able to use it, no matter how critical the situation is. Similarly, the compatibility of UTP Knowledge Based Healthcare Information Services with users' ways of accessing the current web pages available, and general habits and conducts is a precedent condition for service adoption and therefore independent from different use situations.

4.6 UML Diagrams

4.6.1 Use Cases

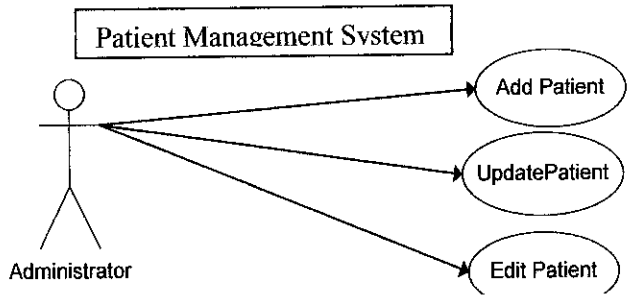

Figure 7: Use Case for Patient Management System

From Figure 7 we can see that the administrator of the system has the privileges of adding patients, updating patient's details and editing patient details from their previous registration in the patient management system.

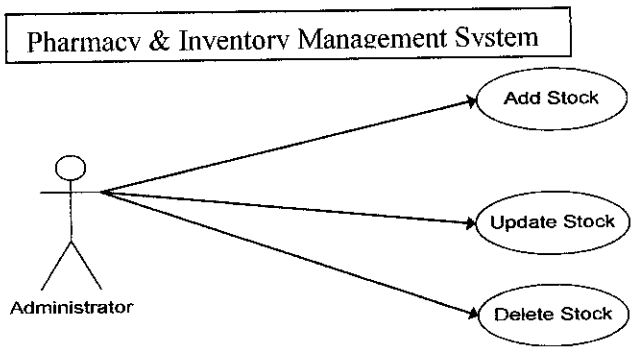

Figure 8: Use Case for Pharmacy & Inventory Management System

Figure 8 shows the administrator's role in the pharmacy and inventory management system. Here, the administrator can add, update and delete stocks.

4.6.2 Class Diagram

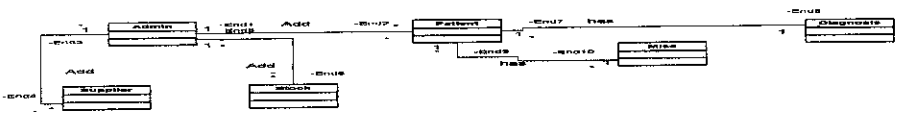

Figure 9: Class Diagram

Based on Figure 10, 1 admin can register * patient at a time. 1 admin can view * stock at a time, and * supplier at a time. 1 patient can have many miscellaneous and diagnosis at a time and view many forums at a time.

4.6.3 Activity Diagram

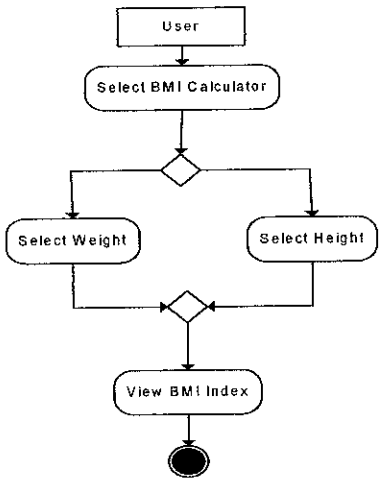

Figure 10: Activity Diagram

This is the activity diagram for the BMI Calculator. The flow of activities in the BMI Calculator is first to select the link, then the weight and height is inserted before viewing the BMI index.

4.6.4 Sequence Diagrams

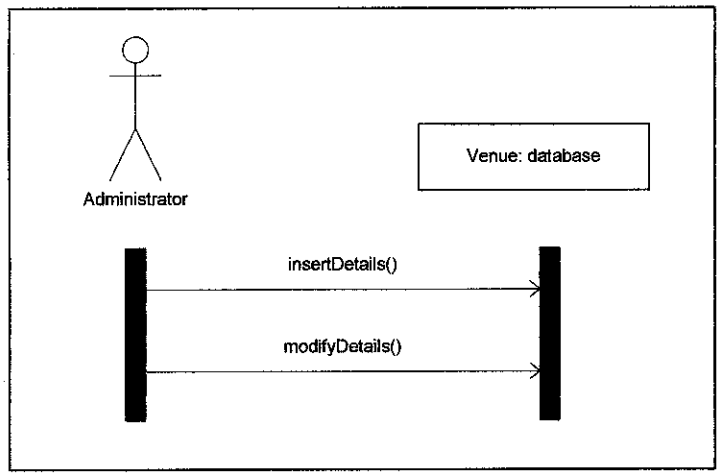

Figure 11: Sequence diagram for add patient

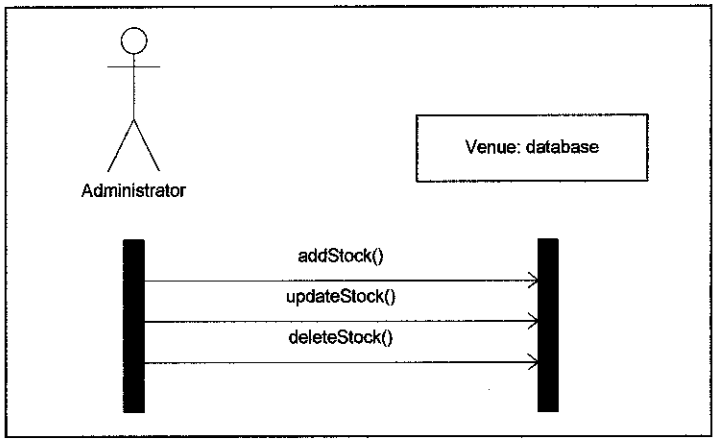

Figure 12: Sequence diagram for add stock

4.7 Design Document

No.	Tool	Hardware Requirements	Software Requirements	Usage	Advantages
1	Visual Basic 2005	host server hardware specification	Used with IIS web server	To prepare GUI interface for the system and hardcoding	Small file size, sufficient documentation and online support, open source, can be programmed with any .NET language, drag and drop.
2	IIS Server	host server hardware specification	Windows Servie Pack 2.0	To host the proposed system to allow centralized access to system by system stakeholders	Small file size, sufficient documentation and online support, open source, can be programmed with any .NET language
3	Microsoft SQL SERVER 2000	host server hardware specification	Used with VB web server, microsoft based	To host the Database of the proposed system to allow centralized access to system by system stakeholders	Small file size, documentation and online support, platform dependent

Table 9: Design Document

4.8 Process Flow

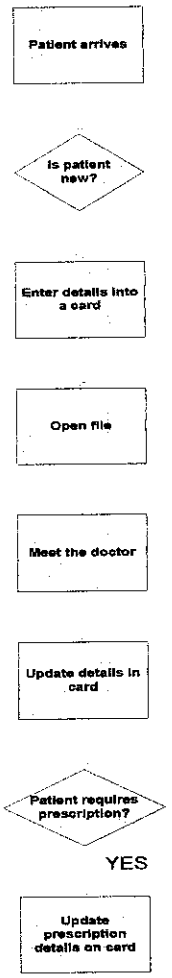

Figure 13: Process Flow of Patient Management System

When a new patient arrives, it enters the decision symbol as to whether the patient is new. If the patient is new, then their details are entered into the database. Then the patient meets the doctor and there is an update of details. If the patient requires a prescription, then the details are updated in the database based on that. The process ends after that.

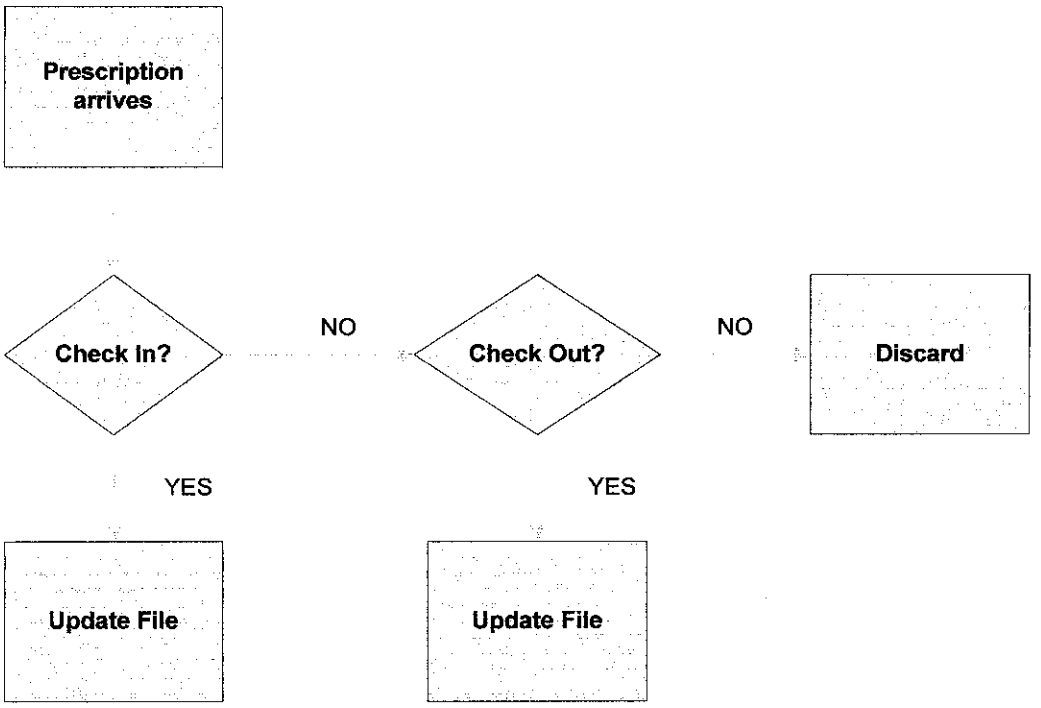

Figure 14: Process Flow of the Pharmacy and Inventory Management System

When the prescription arrives, it goes through a decision making symbol whether it is to be checked in. If yes, then the file is updated. If not the prescription is checked whether it is to be checked out, if yes then the file is updated, else it's discarded.

4.9 Interface Design

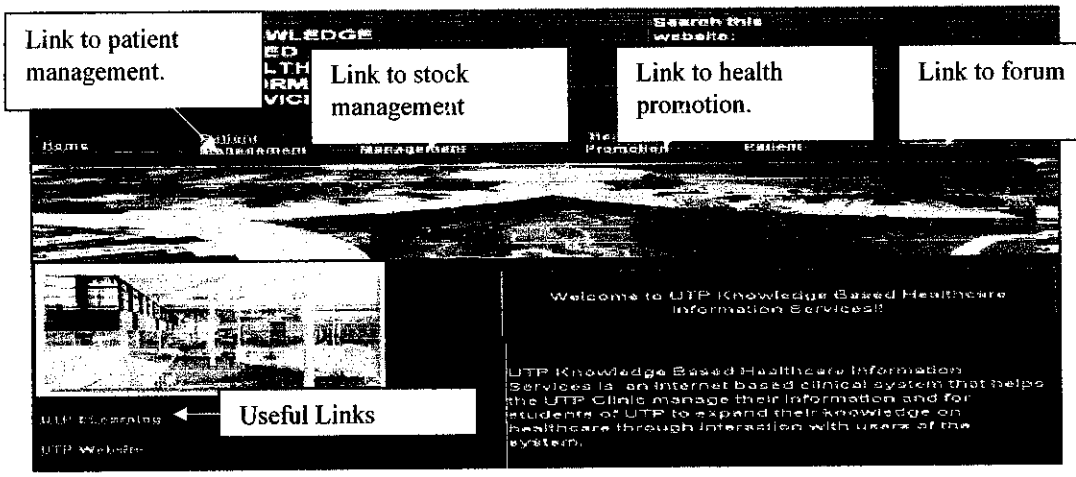

Figure 15: Homepage

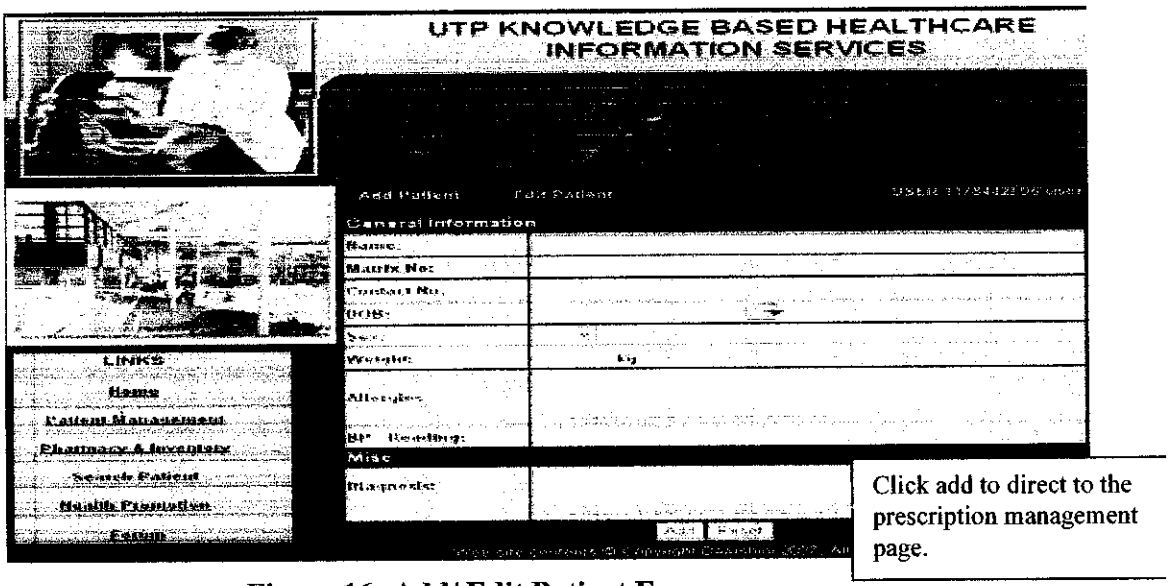

Figure 16: Add/ Edit Patient Form

This form is to keep patient's details and medical records. The clinic staff will insert this data when patients come and register at the clinic. When the add button is clicked it will direct to the stock management link to add the current patient's medicine requirements.

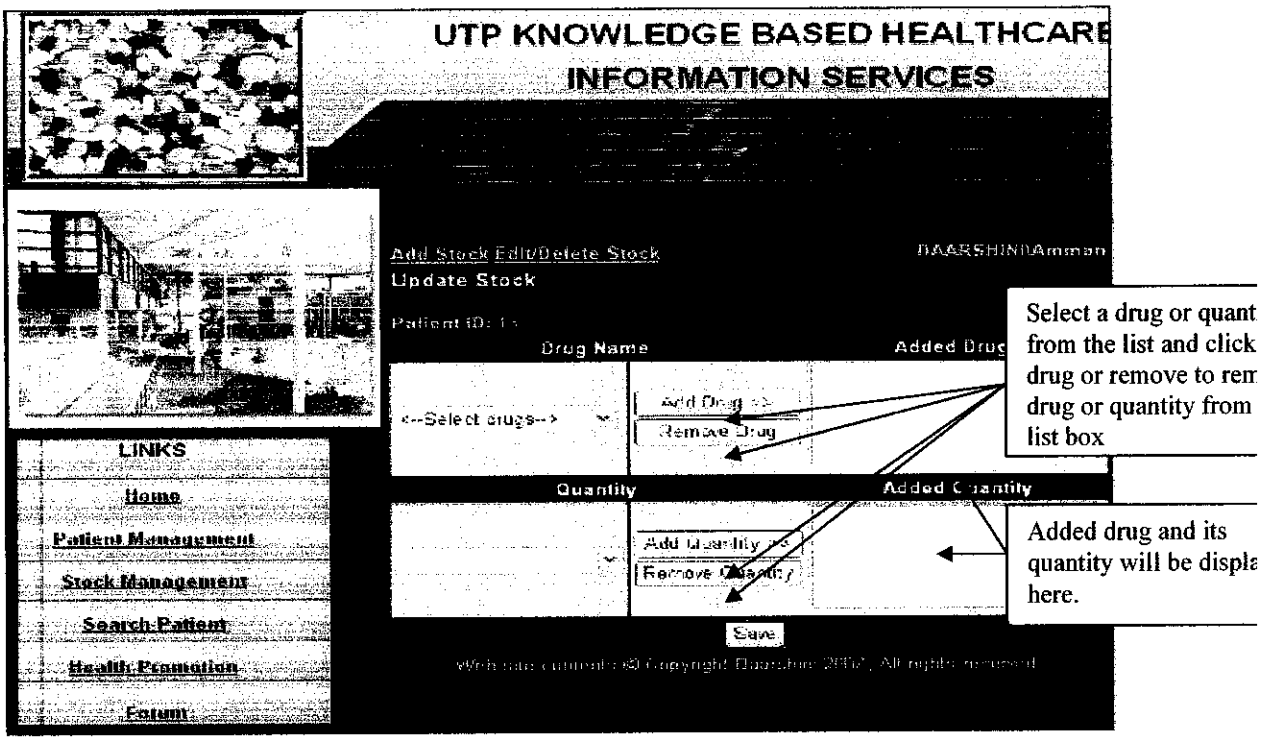

Figure 17: Add/ Edit / Delete Stock Form

This form keeps the drug stock quantities updated based on the quantity each patient takes of the medications. This page comes after the redirection from Add Patient.

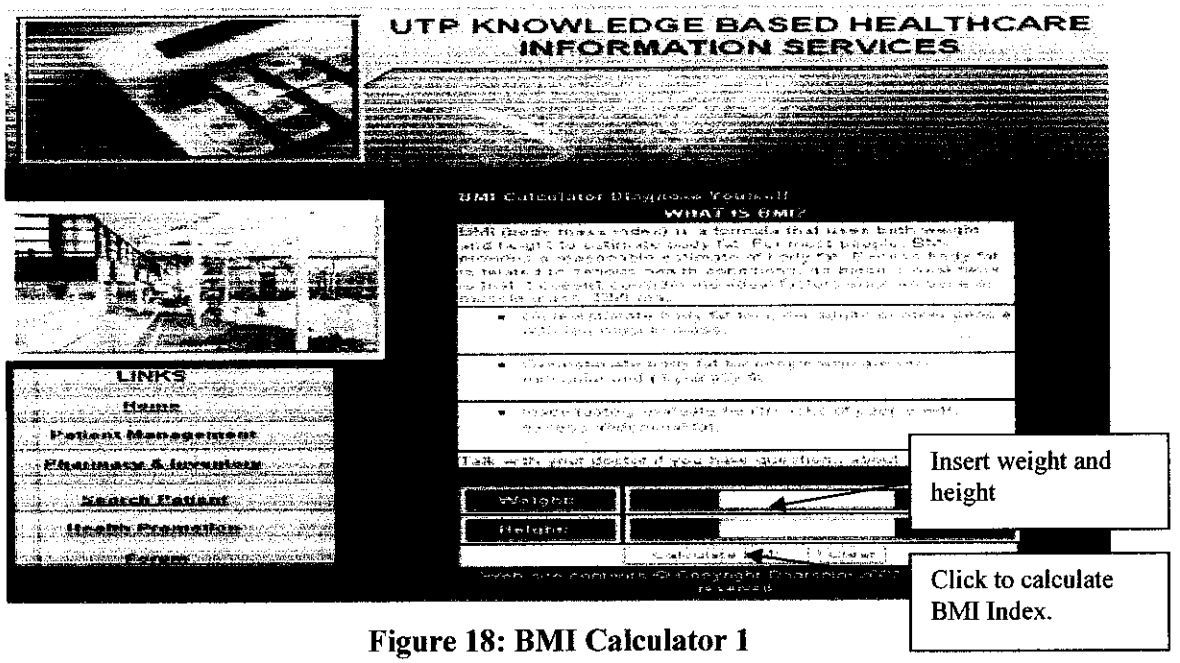

Figure 18: BMI Calculator 1

This is the BMI (Body Mass Index) Index Calculator. Users have to insert their weight and height to see if they are proportional.

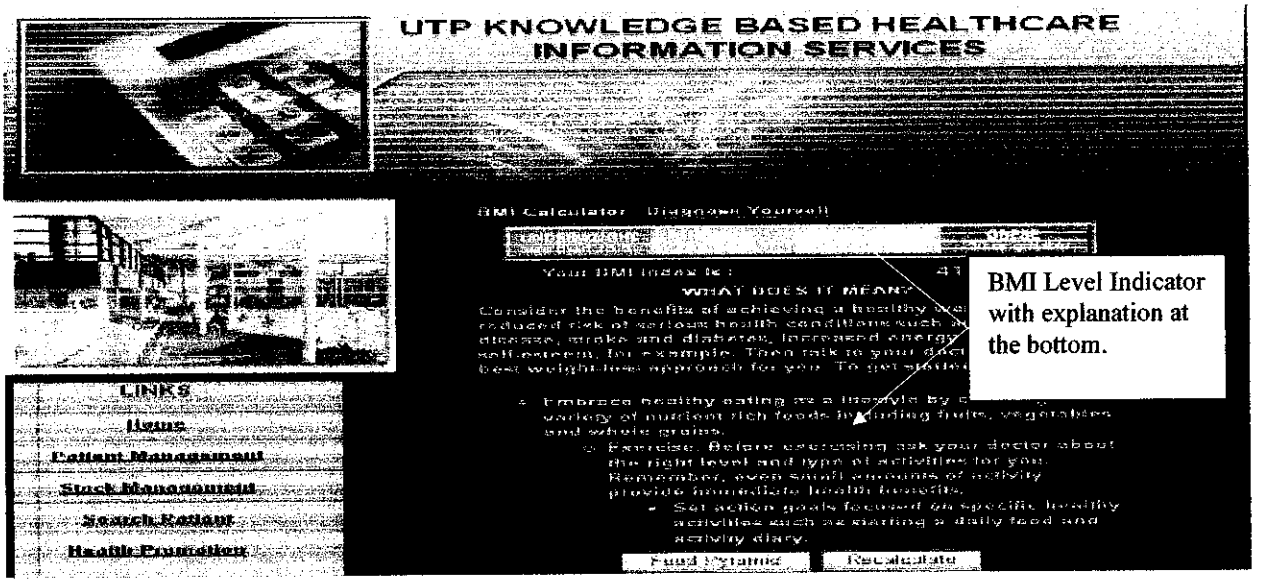

Figure 19: BMI Calculator 2

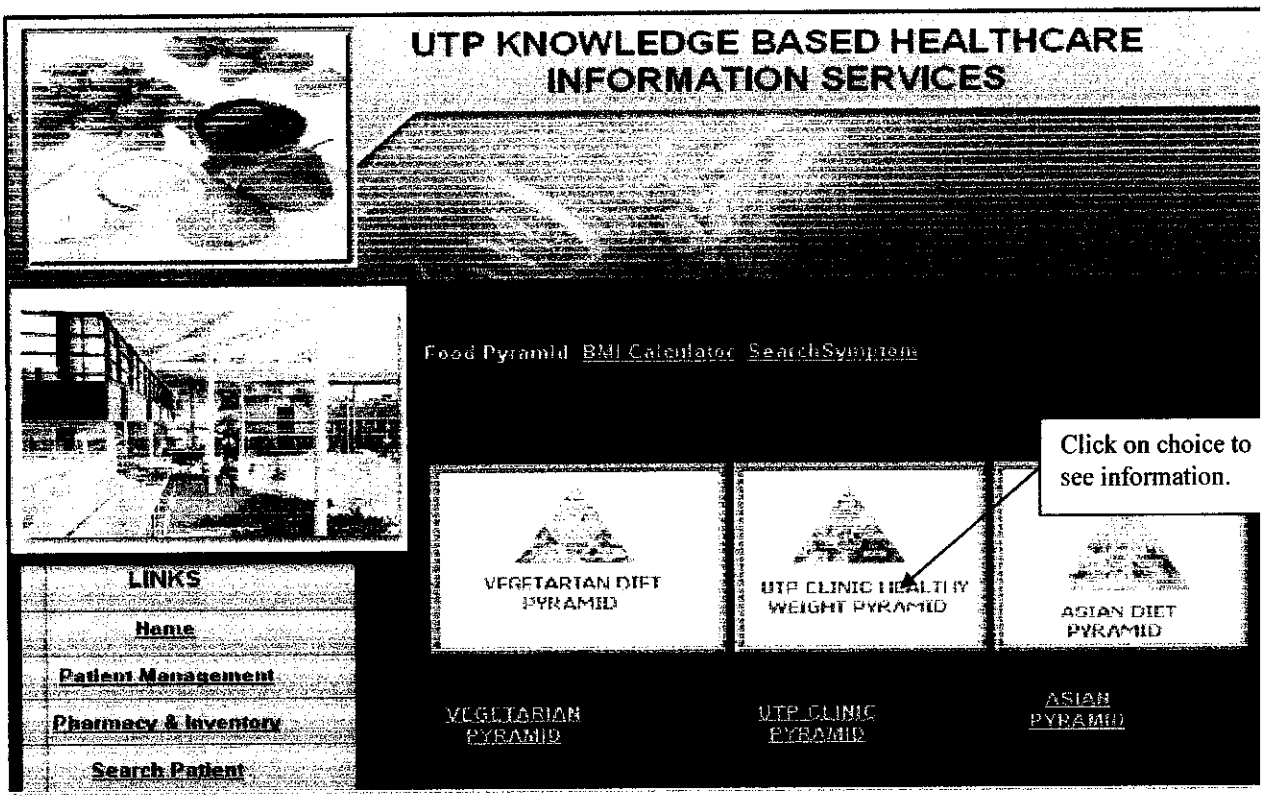

Figure 20: Food Pyramid

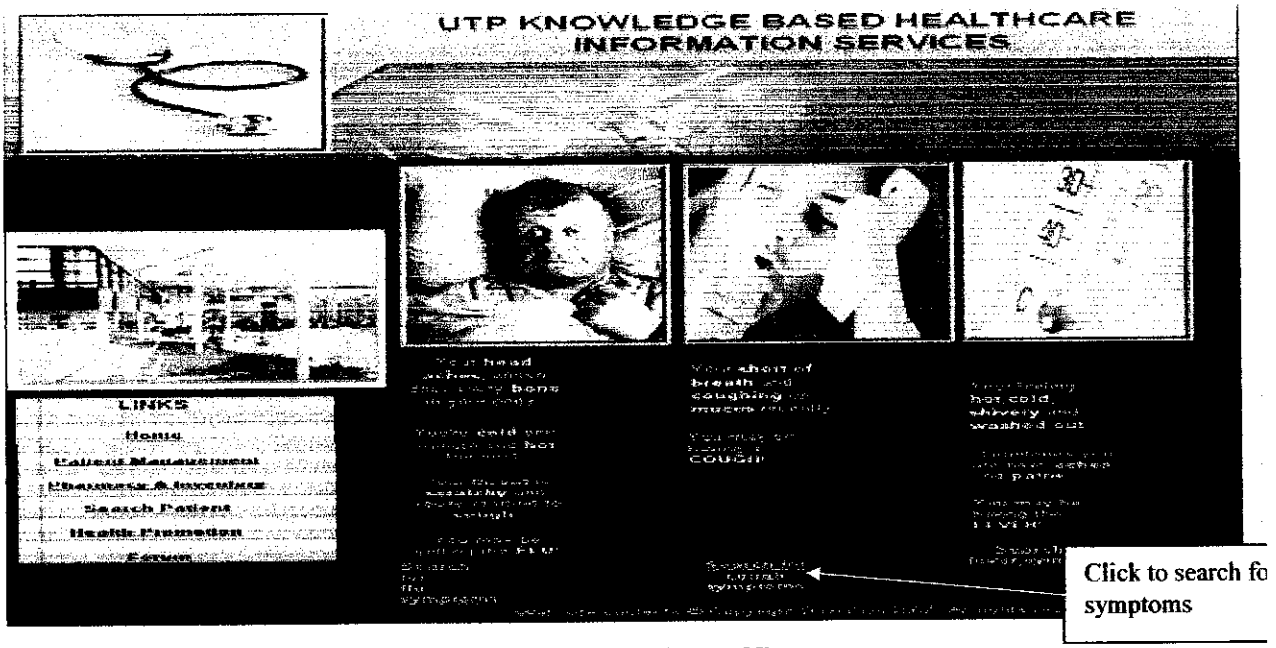

Figure 21: Diagnose Yourself!

This "Diagnose Yourself!" section is an example of Knowledge Based in this system. Users take this quiz of the symptoms of common sicknesses to determine if they have any of those illnesses.

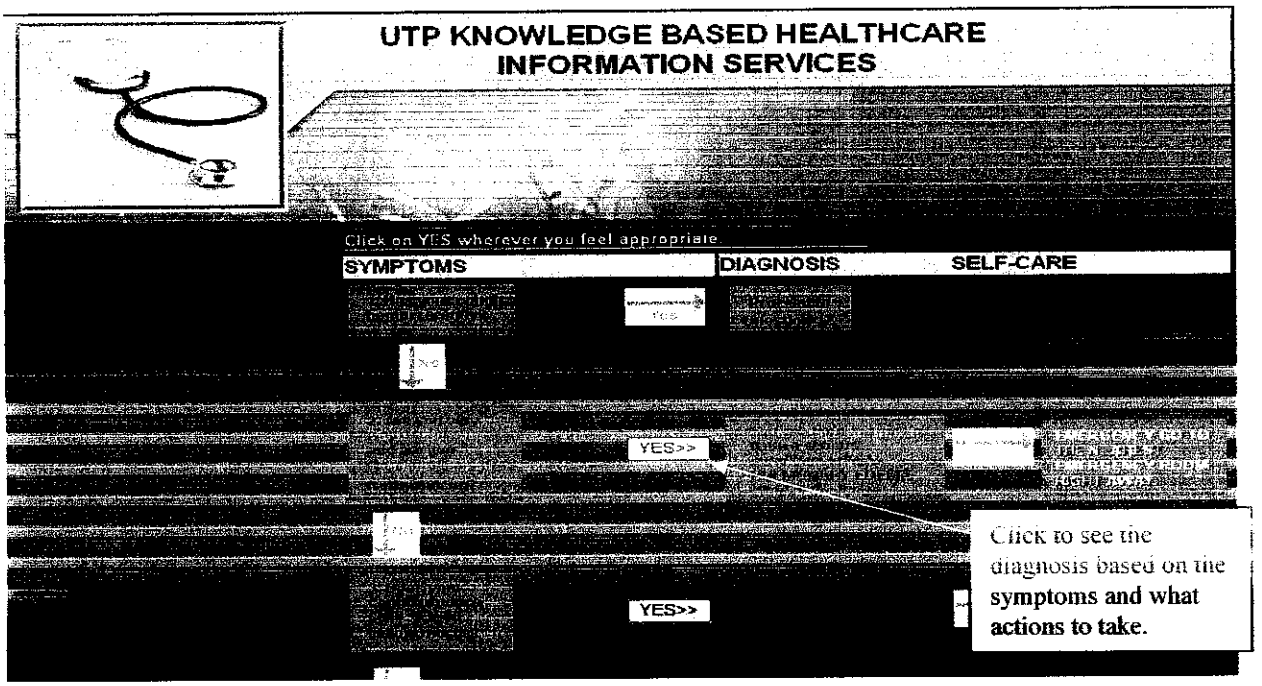

Figure 22: Symptoms of Cough Page

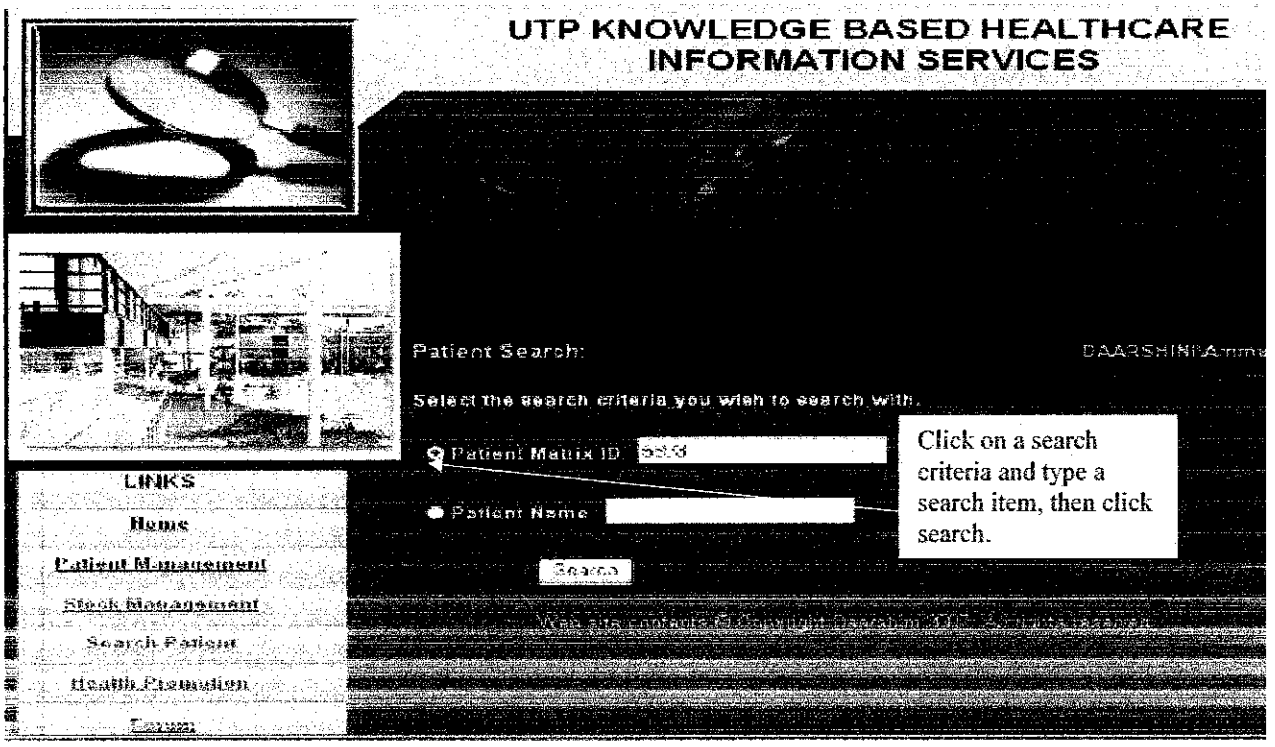

Figure 23: Search Page

This form is used to search patient's details to be able to update it.

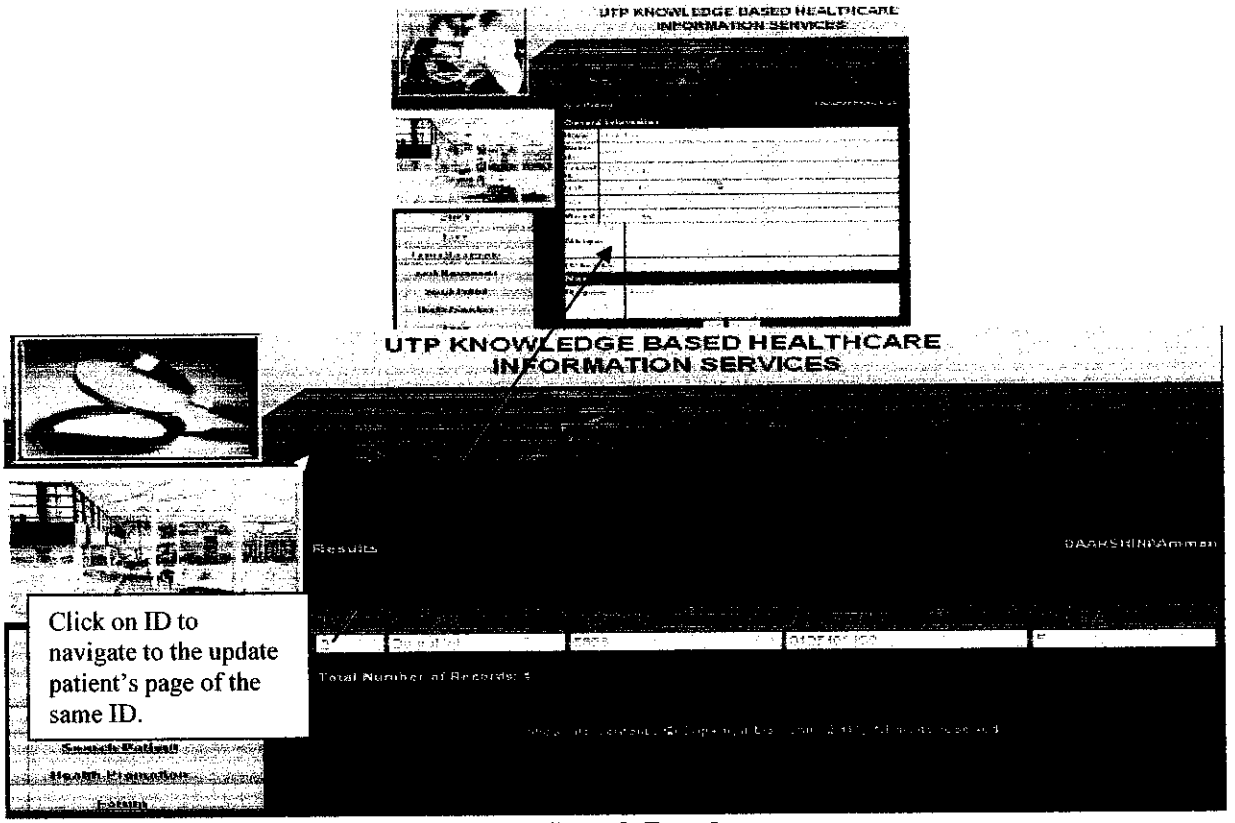

Figure 24: Search Results

The current details of that particular patient with that ID will be displayed in the update form for admin to edit accordingly.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

UTP Knowledge Based Healthcare Information Web Services is an Internet-based clinical and hospital information system that provides a set of web services that healthcare providers (MOH, MMA, GP, pharmacists, nurses and so forth) can use to manage their information. Thus, UTP Knowledge Based Healthcare Information Web Services will be developed to meet specific needs of user requirements while enhancing the efficiency of the current semi manual system used by the UTP Health Clinic.

5.2 Recommendation

1. Deployment of UTP Knowledge Based Healthcare Information Services over the web

Healthcare Information Services when deployed on the web will promote usability and accessibility of Healthcare Information Services to all system stakeholders regardless of time or geographical locations.

2. To add more functions to the Health Promotion module

Health Promotion module is currently added with the BMI Calculator and the "Diagnose yourself!" feature. Therefore, based on the issues students were interested in perhaps tools for stress management and smoking could be added in order to educate users on these issues.

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APPENDICES

Appendix 1-1: Sample of interview questions

Appendix 1-2: Sample of questionnaire questions

Appendix 1-3: Sample of post-test questions

Appendix 1-4: Gantt chart

Appendix 1-5: Milestones

Appendix 1-6: System Codes

APPENDIX 1-1: INTERVIEW QUESTIONS

INTERVIEW QUESTIONS

1. Choose yes or no for the following depending on whether they exist or not in the UTP Health Clinic.

Modules	Yes	No
Patient Management System		
Pharmacy and Inventory Management System		
Prescription Management System		
Appointment System		

2. Explain the current process flow of the Patient Management System.
3. Explain the current process flow of the Pharmacy and Inventory Management System.
4. Explain the current process flow of the Prescription Management System.
5. Explain the current process flow of the Appointment System.
6. Is the current method of filing information and paper dependency feasible?
7. Will you be interested in implementing the Healthcare Information Services in the UTP Health Clinic?

APPENDIX 1-2: QUESTIONNAIRE QUESTIONS

UTP Knowledge Based Healthcare Information Services Questionnaire

Name: _____ Year: _____

Course: _____ Country: _____

Race: _____

UTP Knowledge Based Healthcare Information Web Services is an internet-based hospital and clinical system that provides a set of web services providers (MOH, MMA, and GP, pharmacists, nurses and so forth) can use to manage their information and for users to get cheap medical advice from an expert. This service will meet a growing practice's need for standardization and flexibility. It is an electronic substitute for the paper based system and will become a tool to assure the quality of healthcare delivered.

1. Will you be interested in using UTP Knowledge Based Healthcare Information Web Services if it was to be implemented in UTP in coordination with the UTP Health Clinic?

Yes ☐ No ☐

2. Rank your level of criteria's which interest you from the highest (as 1) to the lowest (as 5).

Accuracy ☐

User Friendliness ☐

Confidentiality ☐

Mode of Delivery ☐

State your mode of delivery: _____

Others ☐

3. If you would like to learn more among these listed health issues rank your highest (1) and lowest (6) interest.

Weight Management ☐

Nutrition ☐

Smoking ☐

Stress Management ☐

Insomnia ☐

Depression ☐

4. Besides these listed issues, are there any other issues that interest you? Please state if any.

_____

APPENDIX 1-3: POST TEST QUESTIONNAIRE QUESTIONS

Program	
Year	
Sponsor	
Gender	☐ Male ☐ Female

Hello. I am currently conducting a study to understand your perspective on whether UTP Knowledge Based Healthcare Information Services (UTP KBHIS) is useful to educate you on healthcare and also healthcare management. This information is needed to evaluate the **success** of the implementation of a **Clinical Management System (UTP Knowledge Based Healthcare Information Services.)**

The following are the proposed functionalities for the system (called UTP Knowledge Based Healthcare Information Services):

1. Module 1: Patient Management
   a. Adding Patient
   b. Editing Patient
   c. Updating Patient

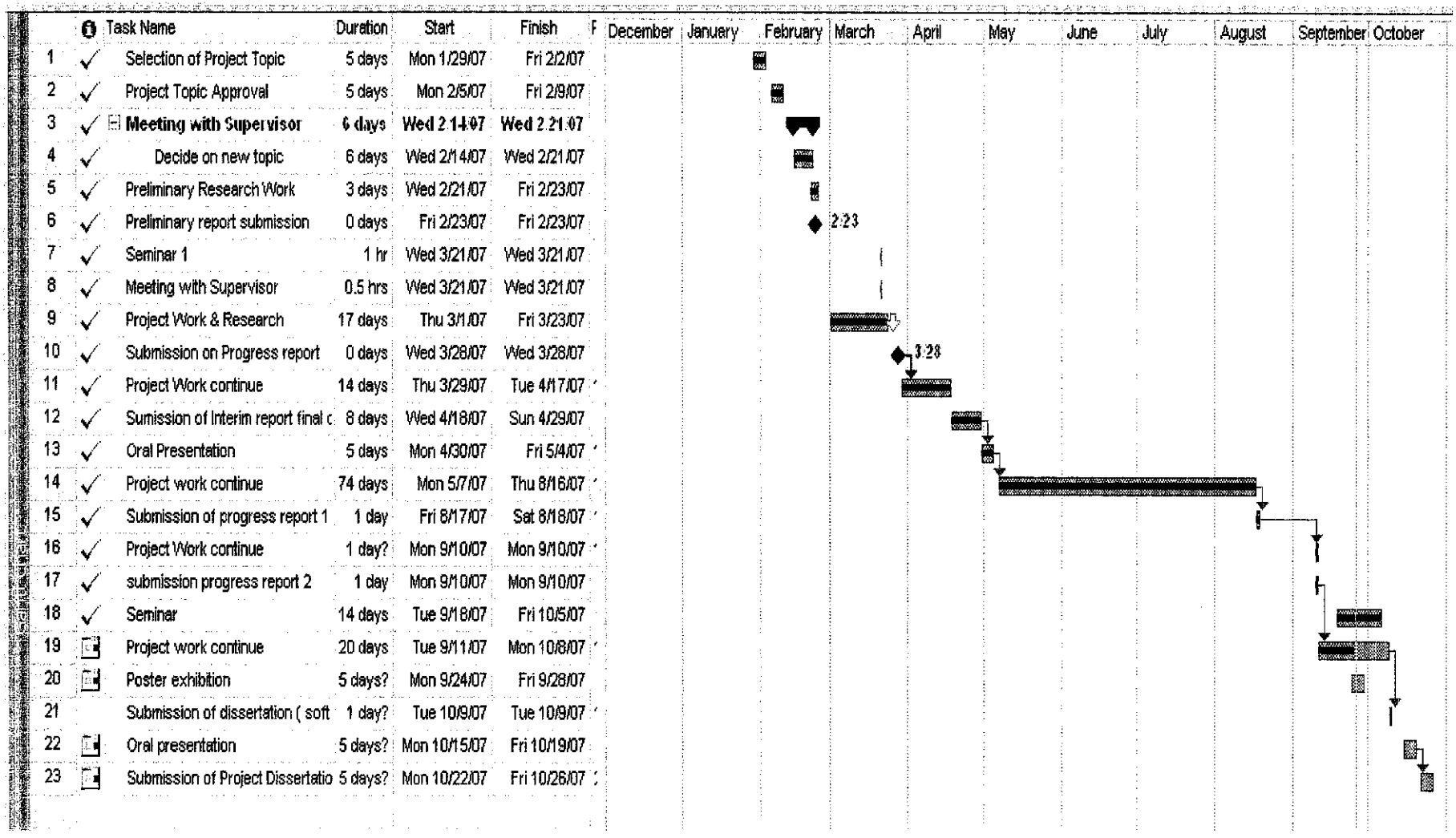
2. Module 2: Inventory Management
   a. Adding Stock
   b. Editing Stock
   c. Updating Stock

3. Module 3: Health Promotion
   a. BMI Calculator
   b. Diagnose Yourself!

The users of this system would be primarily **students**, lecturers and the UTP Health Clinic staff. I would appreciate if you could comment on the prototype of this system by filling in this questionnaire.

Measurement Items	**a) Rating Scale** ***(Circle one answer)***							**b) Reason(s) for Rating**
Ease of Use								
Learning to use UTP KBHIS is easy	1	2	3	4	5	6	7	
Using the Patient Management module is easy	1	2	3	4	5	6	7	
Using the Inventory Management module is easy	1	2	3	4	5	6	7	
Using the Health Promotion module is easy	1	2	3	4	5	6	7	
Usefulness								
It is faster to manage patients using UTP KBHIS	1	2	3	4	5	6	7	
It's easier to manage inventory using UTP KBHIS	1	2	3	4	5	6	7	
It's easier to learn about healthcare using UTP KBHIS	1	2	3	4	5	6	7	
It's easier to keep track with your health using UTP KBHIS	1	2	3	4	5	6	7	
Compatibility								
UTP KBHIS is compatible with the current web pages available	1	2	3	4	5	6	7	
UTP KBHIS is a suitable tool for me to monitor my health	1	2	3	4	5	6	7	
UTP KBHIS is compatible with my style and habits(i.e. delivery method and frequency)	1	2	3	4	5	6	7	
Use Situation								
I use/expect to use UTP KBHIS r if:								
I am in a hurry or need to check my health condition fast	1	2	3	4	5	6	7	
I need to add/edit/delete patients	1	2	3	4	5	6	7	
I need to add/edit/delete stock	1	2	3	4	5	6	7	
I need to clear my doubts on health matter	1	2	3	4	5	6	7	
Use Intention								
I intend to use UTP KBHIS when it is deployed	1	2	3	4	5	6	7	
I believe I will use UTP KBHIS to address my health needs in the future	1	2	3	4	5	6	7	
I believe my interest towards UTP KBHIS will increase when I use it	1	2	3	4	5	6	7	

APPENDIX 1-4: GANTT CHART



	Task Name	Duration	Start	Finish
1	Selection of Project Topic	5 days	Mon 1/29/07	Fri 2/2/07
2	Project Topic Approval	5 days	Mon 2/5/07	Fri 2/9/07
3	**Meeting with Supervisor**	**6 days**	**Wed 2/14/07**	**Wed 2/21/07**
4	Decide on new topic	6 days	Wed 2/14/07	Wed 2/21/07
5	Preliminary Research Work	3 days	Wed 2/21/07	Fri 2/23/07
6	Preliminary report submission	0 days	Fri 2/23/07	Fri 2/23/07
7	Seminar 1	1 hr	Wed 3/21/07	Wed 3/21/07
8	Meeting with Supervisor	0.5 hrs	Wed 3/21/07	Wed 3/21/07
9	Project Work & Research	17 days	Thu 3/1/07	Fri 3/23/07
10	Submission on Progress report	0 days	Wed 3/28/07	Wed 3/28/07
11	Project Work continue	14 days	Thu 3/29/07	Tue 4/17/07
12	Sumission of Interim report final c	8 days	Wed 4/18/07	Sun 4/29/07
13	Oral Presentation	5 days	Mon 4/30/07	Fri 5/4/07
14	Project work continue	74 days	Mon 5/7/07	Thu 8/16/07
15	Submission of progress report 1	1 day	Fri 8/17/07	Sat 8/18/07
16	Project Work continue	1 day?	Mon 9/10/07	Mon 9/10/07
17	submission progress report 2	1 day	Mon 9/10/07	Mon 9/10/07
18	Seminar	14 days	Tue 9/18/07	Fri 10/5/07
19	Project work continue	20 days	Tue 9/11/07	Mon 10/8/07
20	Poster exhibition	5 days?	Mon 9/24/07	Fri 9/28/07
21	Submission of dissertation (soft	1 day?	Tue 10/9/07	Tue 10/9/07
22	Oral presentation	5 days?	Mon 10/15/07	Fri 10/19/07
23	Submission of Project Dissertatio	5 days?	Mon 10/22/07	Fri 10/26/07

APPENDIX 1-5: MILESTONES

Week	Agenda
W2	
W3	**Progress Report 1** Wed: 08th Aug 07
W4	
w6	
w8	**Progress Report 2 (final draft)** Wed: 19th Sep 07
w9	**Seminar – Progress Reporting** Mon – Fri (24th – 28th Sep 07)
w10	**Exhibition/PreEdx (One day event)** Tentatively: Wed; 03rd Oct 07 **Final Report– No extension!** Fri: 05th Oct 07
w12	
w13	**Oral Presentation – Final Reporting** Mon – Fri (22rd - 26th oct 07)
w14	**Submit Dissertation** Fri: 02nd Nov 2007

APPENDIX 1-6: SYSTEM CODES

Add Patient.aspx.cs

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using System.Data.SqlClient;

public partial class AddPatient : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        TDataSource ds = new TDataSource();
        DataTable dt;
        ds.OpenDatabase();
        lblUserID.Text =
Request.ServerVariables["LOGON_USER"].ToString();

        dt = ds.Select("SELECT * FROM Admin WHERE loginID = '"+
lblUserID.Text +"'");
        if (dt.Rows != null)
        {
            if (dt.Rows.Count > 0)
            {
                btnAdd.Enabled = true;
                btnReset.Enabled = true;
                bdpDOB.Enabled = true;
            }
            else
            {
                lblError.Text = "Sorry, your not authorized to use this
page.";
            }
        }
        ds.CloseDatabase();
    }
    protected void Button1_Click(object sender, EventArgs e)
    {
        TDataSource ds = new TDataSource();
        ds.OpenDatabase();
        DataTable dt;
        string sql;
        int sqlResult;
        int id;
        string Name = txtName.Text.Replace("'", "''");
        string matrix = txtMatrix.Text.Replace("'", "''");
        string contact = txtPh.Text.Replace("'", "''");
        string sex = ddlSex.Text.Replace("'", "''");
        string weight = txtWeight.Text.Replace("'", "''");
        string allergies = txtAllergies.Text.Replace("'", "''");
        string bp = txtBP.Text.Replace("'", "''");
```

```
        string diagnosis = txtDiagnosis.Text.Replace("'", "''");


        if (Name == "")
        {
            lblError.Text = "Please fill in the name of the patient.";
        }

        else if (matrix == "")
        {
            lblError.Text = "Please fill in the patient's matrix ID.";
        }

        dt = ds.Select("SELECT * FROM Patient WHERE matrixNo = '" +
matrix + "'");
        if (dt.Rows.Count > 0)
        {
            lblError.Text = "This patient already exists.";
        }

        else if (contact == "")
        {
            lblError.Text = "Please fill in the patient's contact
number";
        }

        else if (bdpDOB.IsNull)
        {
            lblError.Text = "Please fill in the patient's Date of
Birth.";
        }

        else if (sex == "")
        {
            lblError.Text = "Please fill in the patient's sex.";
        }

        else if (weight == "")
        {
            lblError.Text = "Please fill in the patient's weight.";
        }

        else if (allergies == "")
        {
            lblError.Text = "Please fill in the patient's allergies.";
        }

        else if (bp == "")
        {
            lblError.Text = "Please fill in the patient's blood pressure
rate.";
        }

        else if (diagnosis == "")
        {
            lblError.Text = "Please fill in the patient's diagnosis.";
        }
```

```
        else
        {
            sql = "INSERT INTO Patient(name,matrixNo,contactNo,DOB, Sex,
weight, allergies)VALUES('" + Name + "','" + matrix + "','" + contact +
"','" + bdpDOB.SelectedDate + "','" + sex + "', '" + weight + "','" +
allergies + "')";
            sqlResult = ds.ExecNonQuery(sql);

            sql = ("SELECT MAX(patient_ID) FROM Patient");
            id = ds.ExecScalarInt(sql);

            sql = "INSERT INTO Misc(id,bp)VALUES(" + id + ",'" + bp +
"')";
            sqlResult = ds.ExecNonQuery(sql);

            sql = "INSERT INTO
Diagnosis(id,entry_date,diagnosis)VALUES(" + id + ",GETDATE(),'"+
diagnosis +"')";
            sqlResult = ds.ExecNonQuery(sql);
            Response.Redirect("UpdateStock.aspx");
        }
        ds.CloseDatabase();
    }
    protected void btnReset_Click(object sender, EventArgs e)
    {
        Response.Redirect("AddPatient.aspx");
    }
                                    }
```

BMICaic.aspx.cs

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class BMI_Calc : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {

    }

    protected void Button1_Click(object sender, EventArgs e)
    {

        TValidation dv = new TValidation();


        Session["HEIGHT"] = txtHeight.Text.Replace("'", "''");
```

```
        Session["WEIGHT"] = txtWeight.Text.Replace("'", "''");

        if (!TValidation.IsNumber(txtWeight.Text))
        {
            lblError.Text = "This is not a valid number.";
        }
        else if (txtWeight.Text == "")
        {
            lblError.Text = "Please enter your weight.";
        }
        else if (!TValidation.IsNumber(txtHeight.Text))
        {
            lblError.Text = "This is not a valid number.";
        }
        else if (txtHeight.Text == "")
        {
            lblError.Text = "Please enter your height.";
        }
        else
        {
            Response.Redirect("BMICalc2.aspx");
        }
    }
    protected void Button2_Click(object sender, EventArgs e)
    {
        Response.Redirect("BMICalc.aspx");
    }
}
```

Results.aspx.cs

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Result : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        TDataSource ds = new TDataSource();
        DataTable dt;
        DataTable dt2;
        ds.OpenDatabase();
        lblUserID.Text =
Request.ServerVariables["LOGON_USER"].ToString();

        dt = ds.Select("SELECT * FROM Admin WHERE loginID = '" +
lblUserID.Text + "'");
        if (dt.Rows != null)
        {
```

```
            if (dt.Rows.Count > 0)
            {
                dgrdResults.Enabled = true;
        string patientName = Session["name"].ToString();
        string matrixNo = Session["MatrixID"].ToString();
        string contactNo = "";
        string sex = "";
        string radName = Session["selectName"].ToString();
        string radMatrixID = Session["selectMatrixID"].ToString();
        string patientID="";

        Session["formid"] = patientID;
        if (radMatrixID == "True")
        {
            dt = ds.Select("SELECT
patient_ID,name,matrixNo,contactNo,Sex FROM Patient WHERE matrixNo = '"
+ matrixNo + "'");
            for (int i = 0; i < dt.Rows.Count; i++)
            {
                if (dt.Rows.Count > 0)
                {
                    patientID = dt.Rows[i]["patient_ID"].ToString();
                    patientName = dt.Rows[i]["name"].ToString();
                    matrixNo = dt.Rows[i]["matrixNo"].ToString();
                    contactNo = dt.Rows[i]["contactNo"].ToString();
                    sex = dt.Rows[i]["Sex"].ToString();
                }

                //display data
                dgrdResults.DataSource = dt;
                dgrdResults.DataBind();
                lblNoOfRec.Text = "Total Number of Records: " +
dt.Rows.Count.ToString();
            }

        }

       if (dt.Rows.Count == 0)
        {
            lblNoOfRec.Text = "No matching records found.";
        }

        if (radName == "True")
        {
            dt2 = ds.Select("SELECT
patient_ID,name,matrixNo,contactNo,Sex FROM Patient WHERE name LIKE '" +
patientName.ToString().Trim() + "%' ORDER BY name");
            for (int h = 0; h < dt2.Rows.Count; h++)
            {
                if (dt2.Rows.Count > 0)
                {
                    patientID = dt2.Rows[h]["patient_ID"].ToString();
                    patientName = dt2.Rows[h]["name"].ToString();
                    matrixNo = dt2.Rows[h]["matrixNo"].ToString();
                    contactNo = dt2.Rows[h]["contactNo"].ToString();
                    sex = dt2.Rows[h]["Sex"].ToString();
                }
```

```
                //display data
                dgrdResults.DataSource = dt2;
                dgrdResults.DataBind();
                lblNoOfRec.Text = "Total Number of Records: " +
dt2.Rows.Count.ToString();
            }
            if (dt2.Rows.Count == 0)
            {
                lblNoOfRec.Text = "No matching records found.";
            }
        }


        ds.CloseDatabase();
    }
}
else
{
    lblError.Text = "Sorry, you're not authorized to use this page.";
}
}
}
```

Search.aspx.cs

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Search : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        TDataSource ds = new TDataSource();
        DataTable dt;
        ds.OpenDatabase();
        lblUserID.Text =
Request.ServerVariables["LOGON_USER"].ToString();

        dt = ds.Select("SELECT * FROM Admin WHERE loginID = '" +
lblUserID.Text + "'");
        if (dt.Rows != null)
        {
            if (dt.Rows.Count > 0)
            {
                btnSearch.Enabled = true;
            }
            else
            {
```

```
                lblError.Text = "Sorry, your not authorized to use this
page.";
            }
        }
    }
    protected void btnSearch_Click(object sender, EventArgs e)
    {
        TValidation dv = new TValidation();

        Session["selectMatrixID"] = radMatrixID.Checked;
        Session["selectName"] = radName.Checked;
        Session["MatrixID"] = txtMatriXID.Text.Replace("'", "''");
        Session["name"] = txtName.Text.Replace("'", "''");

        string matrix = txtMatriXID.Text;

        if (radName.Checked == false && radMatrixID.Checked == false)
        {
            lblError.Text = "Please select a search criteria.";
        }

        else
        {
            if (radMatrixID.Checked == true)
            {
                if (!TValidation.IsNumber(matrix))
                {
                    lblError.Text = "This is not a valid Matrix ID.";
                }

                if (matrix == "")
                {
                    lblError.Text = "Please enter a Matrix ID.";
                }

                else
                    Response.Redirect("Result.aspx");
            }
            else if (radName.Checked == true)
            {
                if (txtName.Text == "")
                {
                    lblError.Text = "Please enter a recipient name.";
                }
                else
                    Response.Redirect("Result.aspx");
            }

        }
    }
}
```